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Edgar Zilsel

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Perry Miller

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VOLUME II, NUMBER 1 JANUARY, 1941

THE ORIGINS OF WILLIAM GILBERT'S SCIENTIFIC METHOD*

BY EDGAR ZILSEL

William Gilbert's *De Magnete* appeared in 1600, six years before Galileo's first publication, five years before Bacon's *Advancement of Learning;* it is the first printed book, written by an academically trained scholar and dealing with a topic of natural science, which is based almost entirely on actual observation and experiment. In the learned literature of the period, among the writings of both contemporary university scholars and the humanistic literati, it is an isolated case. An analysis of the origins of its scientific method, therefore, is not only interesting in itself but is likely to throw some light on the origins of modern natural science in general. The results of Gilbert's investigation of magnetism and electricity being generally known, we shall consider first a few characteristics of his method and shall then try to trace its sources. Unfortunately very little is known of Gilbert's life and nothing at all of his way of working. The investigation, therefore, must be based entirely on his two printed books.[1]

* This essay is part of a study undertaken with the help of grants from the Committee in Aid of Displaced Foreign Scholars and the Rockefeller Foundation.

[1] *De Magnete Magneticisque Corporibus et de Magno Magnete Tellure, Physiologia Nova plurimis et argumentis et experimentis demonstrata,* Londini, 1600. If no other source is given all quotations in the following paper refer to this work and this edition. An English page-for-page version by Silvanus P. Thompson has been edited by the William Gilbert Society, Chiswick Press, London 1900. It contains valuable notes. Gilbert's second work is quoted from the only edition, *De Mundo nostro sublunari Philosophia nova, Opus posthumum. Ab Authoris fratre collectum pridem et dispositum. . . .* Amstelodami, 1651.—*De Mundo* does not shed much light on the origin of Gilbert's ideas. We are not even sure whether it was composed before or after *De Magnete.* At the margin of page 139 of *De Mundo* a reference to *De Magnete* VI, 4 is given and a similar remark is added at the end of the chapter. But since the author's brother who edited *De Mundo* declares himself in the preface not to know which of the books was composed earlier, obviously both remarks have been added by the editor later on. On the other hand in *De Mundo* (pp. 118 and 151) two statements of Patrizzi are criticised. These quotations can refer only to Patrizzi's *Nova de Universis Philosophia,* part Pancosmia, book 26 and book 12 respectively (in the second edition, Venice 1593, fol. 132 col. 2 and fol. 91 col. 3). The first edition of Patrizzi's work was printed in 1591. *De Mundo,* therefore, must have been composed after 1591 (Gilbert died in 1603). Altogether *De Mundo* gives

I

1. Gilbert's scientific method combines essentially modern with metaphysical, Scholastic, and animistic elements. Several of his experimental devices are still in use today. He dresses the poles of his spherical loadstones with sheet-iron and thus invents the armature of magnets (II, chap. 17). In order to examine weak magnetic forces he fixes small iron pieces on cork floating on water or suspends them on threads (I, 12 and 13; III, 8; V, 9). He even uses a few physical instruments. One of them is of his own invention and is the first of its kind in the history of physics. It is a—still somewhat imperfect—electroscope which obviously is constructed after the pattern of a magnetic needle (II, 2 p. 49). Besides Gilbert describes at length and illustrates by woodcuts four magnetic measuring instruments, two declinometers and two inclinometers (IV, 12; V, 1; V, 3). They had, however, been neither invented nor essentially improved by him, though Gilbert omits that point.[2]

It is significant with respect to the origin of Gilbert's interest in scientific accuracy that all of his physical instruments are actu-

the impression of greater immaturity; it is more pedantic and contains more remnants of Scholastic terminology than *De Magnete*. The first book of *De Mundo* combats the doctrine of the four elements, the second deals with astronomy, books 3 to 5 discuss "meteorological" problems, beginning with comets, the milky way, and clouds, and ending with the sea and the air. Very few experiments are given. *De Mundo* contains some modern-looking results—*e.g.*, space above the terrestrial atmosphere is thought to be empty and cold—but the methods and arguments are in no way outstanding.

[2] Gilbert's electroscope consists of a light horizontal metal needle, which is put on a point so that it can be turned easily. In *De Magnete* it is called by the same name *versorium* that is employed for magnetic needles.—The description of Gilbert's four magnetic measuring instruments must be omitted here. The declinometer was invented in 1525 by Felipe Guillen. It was improved before Gilbert by Francisco Falero (*Tratado del Esphera,* Sevilla 1535), Pedro Nunes (*Tratado da Sphera,* Lisbon 1537), William Borough (*A Discourse of the Variation of the Compass,* London 1581), and Simon Stevin (*De Havenvinding,* Leyden 1599). The inclinometer had been invented by Robert Norman (*The Newe Attractive,* London 1581). These works are reprinted in G. Hellman: *Rara Magnetica, 1269–1599.* (*Neudrucke von Schriften . . . über Erdmagnetismus No. 10*) Berlin 1898. As quotations at other places of *De Magnete* show, the cited works of Nunes, Borough, Norman, and Stevin were known to Gilbert. Gilbert also invented and constructed two nomograms. The first (IV, 12, p. 176) simplifies determination of the astronomical meridian by means of graphic calculus. The second (V, 8)—which, however, is based on incorrect assumptions—is meant to determine graphically geographic latitude.

ally nautical instruments or are at least nearly related to the mariner's compass. On the whole he performs measurements practically only when he deals with quantities which are important in navigation, such as magnetic declination and inclination, altitudes of stars, and geographical latitudes (*e.g.*, IV, 4 p. 160; IV, 12 p. 176; V, 8; VI, 1 p. 214). In other fields he usually restricts himself to qualitative observations and experiments. His best quantitative experiment verifies the hypothesis that magnetism is imponderable by weighing pieces of iron "on most exact gold scales" before and after magnetization (III, 3). It is taken over, however, from the compass-maker Robert Norman without the source being given. The few quantitative investigations which are original with him are not very outstanding.[3] Altogether, quantitative investigation appears considerably developed in *De Magnete* if compared with physics in the Middle Ages; it cannot compare, however, with the use of scientific measurements in the works of Galileo and his followers. Calculations are lacking entirely.

Mechanics also plays a very small part in *De Magnete*. Twice Gilbert shows some mechanical insight. Once (II, 35) he vehemently attacks medieval attempts to construct a perpetual motion engine. At another time (II, 24 p. 92) he knows that unstable equilibrium cannot persist for a long time and that, therefore, Fracastoro's story of a piece of iron suspended in the air between the earth and a magnet is "absurd." These two passages, however, are the only ones in his book dealing with mechanical questions. Both the interest in mechanics and the mechanical interpretation of all natural phenomena which dominated physics from Galileo to the nineteenth century are still lacking in Gilbert.

2. It is not easy to draw the picture of Gilbert's scientific attitude correctly. He is usually as critical-minded as a modern experimentalist, does not rely on any authority, and always tests reports of others by his own experiments. Superstitious ideas are emphatically rejected by him. He derides the ancient and medieval stories of diamonds and garlic destroying magnetism, the stories of magnets detecting faithlessness of women and unlocking locks (pp. 2 f. and 6 f.). He vehemently attacks alchemists and their obscure language (pref. fol. iij; I, 3 pp. 19 f. and 24). He rejects the explanation of electric and magnetic attraction by

[3] II, 17 p. 86; II, 25 p. 92; II, 29 p. 97; II, 32 p. 99; III, 15 p. 145; III, 17 p. 150.

means of sympathy and, on that account, scoffs at Fracastoro (II, 2 p. 50; II, 3 p. 63 f.; II, 4 p. 65; II, 39 p. 113). On the other hand he believes in horoscopes, like most of his contemporaries: the magnetizing effect of the earth on pieces of iron being forged in the smithy is compared by him to the influence of the stars on a child during its birth (p. 142).[4]

Aristotelian and Scholastic concepts play a major part in his theoretical conceptions. Gilbert believes in the two basic principles matter and form, "out of which all bodies are produced" (II, 2 p. 52). In his opinion electric effects get their strength (*invalescunt*) from matter, magnetic effects from a "distinguished" (*praecipua*) form (p. 53), for he thinks that the spherical form of the stars and especially the earth, being "primary and powerful" (I, 17 p. 42), is "the true magnetic potency" (II, 4 p. 65). Obviously his explanation of magnetism is based on the Scholastic metaphysics of active forms. In all his experiments he uses spherical loadstones, although he himself knows (II, 15 p. 83; III, 31 p. 99) that bar-like magnets are more effective. He calls them "little earths" (*terrellae* I, 3) and presumably clings to the medieval shape of his magnets because he believes in a metaphysical connection of spherical form and magnetism.

Cardanus's story that "the magnet lives and feeds on iron" is derided by Gilbert as old women's talk (I, 16 p. 37; II, 3 p. 63). He refutes it, using experimental methods, by ascertaining that the weight of the iron filings in which a magnet is kept does not diminish. Again he proves himself an empiricist, but he is opposed to vitalistic explanations only in so far as they contradict single empirical facts. His own "philosophy" of magnetism, so far as it can neither be confirmed nor disproved by observation, is as animistic as the theory of Cardanus. A chapter of his book (V, 12) is entitled: "The magnetic force is animated or is similar to soul; it by far surpasses the human soul as long as that is bound to an organic body." The chapter refers to ancient philosophers from Thales to the Neoplatonists, who taught the existence of a soul of the universe, and adds the Egyptians, Chaldeans and (p. 209) even authorities on occult science, such as Hermes, Zoroaster and Orpheus. It explains (p. 209 f.) that the earth and the stars have

[4] The astrological theory of correspondence between metals and planets, however, is called "insane" (p. 20). In Gilbert's opinion metals, especially iron, are the very essence of the earth and, therefore, do not depend on the stars.

souls, although they have no sense-organs, and that God himself is soul;[5] and, quoting Thales, it calls the magnet "an animated stone, that is a part and beloved offspring of the animated mother, Earth."

The last quotation shows that Gilbert's theory of magnetism is embedded in a vitalistic philosophy of the terrestrial globe. To him the earth is "the common mother" of all things. Again and again in *De Magnete* this term is repeated, whenever the earth is mentioned.[6] We can therefore scarcely doubt the strongly emotional background of the idea of the maternal earth. The power of the magnet derives directly from the earth in Gilbert's opinion. For nothing but the magnet has preserved (I, 17 p. 42) "this distinguished substance which is homogenous to the internal nature of the earth and most akin to its marrow itself." Iron and magnets are (I, 16 p. 37) "the true and most intimate parts of the earth," because "they retain the first faculties in nature, the faculties of attracting each other, of moving, and of adjusting by the position of the world and the terrestrial globe."

Gilbert was the first to conceive the earth as a large magnet (I, 17; VI, 1). He was the first to teach that the interior of the earth consists of pure iron and that its surface and rim only are "soiled by other impurity" (I, 16 p. 39). Thus he has anticipated important empirical results of modern geophysics. But the resemblance of his magnetic philosophy to modern science is merely a matter of chance. Gilbert's terms "interior" and "intimate" combine spatial and metaphysical meaning and are always used as concepts of value. How near his "magnetic philosophy" still is to medieval vitalism is revealed by the fact that he believes in a metaphysical correlation of magnetism and rotation. He speaks of the "magnetic rotation" of the terrestrial globe (VI, 3 p. 214), and would like to accept the statement of Pierre de Maricourt that a spherical magnet rotates continuously by itself, were it not for his

[5] Gilbert's religious belief obviously is rather Neoplatonic than Protestant. The whole chapter is strongly influenced by Patrizzi. *Cf.* below § 4, footnote 13.

[6] *E.g.* pref. at the beginning and pp. 12, 26, 38 (twice), 41, 117, 152, 210.—Moreover Gilbert likes to compare the interior of the earth with the mother's womb. In his opinion all metals originate from exhalations of the innermost part of the earth that are condensed and congeal nearer the surface in warm cavities "as the sperm or embryo congeals in the warm uterus" (I, 7 p. 20). *De Mundo* advocates the doctrine (p. 39) that all kinds of matter originate in earth and that earth, therefore, is the only element.

conscience as a cautious experimentalist. He reproduces Pierre's statement and adds (VI, 4 p. 223): "until now we have not succeeded in seeing this. We even doubt this movement because of the stone's weight and because the whole earth moves by itself, as it is moved by the other stars also. That does not hold proportionally of some part [the *terrella*]." Everyone who remembers how vehemently Gilbert attacks the reports on perpetual motion machines must notice the difference in emphasis.[7]

II

3. The material thus far presented may serve for a general indication of Gilbert's way of thinking. Animistic and Neoplatonic ideas are abundant in his book; the traces of Scholasticism and astrology are scarcer. But it is not these pre-scientific features that are conspicuous, for his work shares them with the whole learned literature of his period. What really counts is that his animistic metaphysics is nothing but the emotional background of his thinking and does not affect the empirical content of his science. The writings both of the Scholastics and the Renaissance philosophers abound with superstitious stories and magic. Gilbert rejects all that with unswerving criticism and bases his findings on experience and experiment only. This attitude is so exceptional in his period that the question arises where it originates. Since critical minded experimentalists appear more and more frequently among the scholars a few decades after Gilbert, a satisfactory answer would at the same time contribute to the solution of the problem of the origin of modern science in general.

Even in a period in which quoting was more favored by scholars than nowadays, Gilbert is remarkable for the number of his references and his wide reading. He stresses, nevertheless, the novelty of his ideas. His attitude to contemporary literature is explained in the preface of *De Magnete*. There Gilbert says:

> What business have I in that vast ocean of books? . . . By the more silly ones among them the crowd and most impudent people get intoxicated, insane and haughty. . . . They declare themselves to be philosophers, physicians, mathematicians, and astronomers and neglect and despise the

[7] The story of the rotating spherical magnet is mentioned in *De Mundo* also (p. 138). There Gilbert gives the same reasons why the *terrella* does not rotate "although it is fit and inclined by nature to rotation."—In order to understand Gilbert's argument we have to realize that he was among the earliest adherents of Copernicus in England and was already convinced of the rotation of the earth.

learned men. Why should I add any thing to this disturbed literary republic? Or am I to offer this eminent philosophy that because of its unknown contents, as it were, is new and unbelievable to people who blindly trust authorities, to most absurd destroyers of the good arts, to literary idiots, grammarians, sophists, pettifoggers, and perverse mediocrities? . . . No! I have presented these principles of magnetism that belong to a new kind of philosophy, to you true philosophers . . . who look for knowledge not in books only but in things themselves.

Continuing, he announces that he will not call upon ancient writers for help, "because neither Greek arguments nor Greek words" can assist in finding truth. He promises that he will avoid "the ornament of eloquence" and will not darken things by words "as the Alchemists are wont to do." He plans to write with the same "liberty of mind" (*licentia*) as the ancient Egyptians, Greeks, and Romans. The "sciolists" of present times still keep the errors of the ancients, but Aristotle, Theophrastus, Ptolemy, Hippocrates, and Galen themselves are sources of wisdom. "Yet our own period has discovered and brought to light very many things which those men too would be glad to accept if they were alive."

These vehement attacks on believers in authority and words, and the emphasis on the novelty of his ideas, are characteristic of the period of the expiring Renaissance, and anticipate Francis Bacon, and in some degree Galileo also. As the mention of grammarians, Greek words and eloquence shows, Gilbert's attack is aimed at declining humanism. Similar attacks are repeated several times in *De Magnete*.[8] Gilbert's other book, *De Mundo*, contains less polemics and is written more dispassionately. But it also opposes belief in authority: the slogan "he himself has said so, Aristotle has said so, Galen has said so" is considered a nuisance (*De Mundo* I, 3 p. 5).[9]

4. We shall therefore not expect to meet with much agreement with other authors in Gilbert's book. In fact most of the numer-

[8] Gilbert scoffs (I, 1 p. 2) at "precocious sciolists and copyists" who add fictitious stories to ancient authors. He accuses "the modern philosophers" (I, 10 p. 28) of having drawn their knowledge from books rather than from things. He derides (II, 2 p. 48) the books "cramming the bookshops" that deal with mysterious stories instead of experiments, and are as fond of Greek words as barbers who try to impress people by using scraps of Latin. He charges Fracastoro (II, 39 p. 113) with his predilection for Greek words and reproaches "the crowd of philosophers and copyists" (II, 38 p. 109) with repeating old opinions and errors.

[9] As is generally known, the *ipse dixit* (αὐτὸς ἔφα) was the slogan of the Pythagorean school by which they referred to their master.

ous references he gives are critical and negative, whereas the real sources of his ideas are chiefly to be sought elsewhere.

Ancient authors are often quoted. Comparatively favorable judgments are pronounced on philosophers who believe in universal animation, such as Plato and most of the Pre-Socratics. Atomists and mechanists are rejected. The Stoics are not mentioned. Although Gilbert is still greatly influenced by the concept of substantial form, he is opposed to Aristotle. In *De Magnete* (p. 116 and 209) Aristotle's astronomical doctrines are chiefly attacked, in *De Mundo* (I, 3) his doctrine of the four elements. The first book of *De Mundo* is even entitled "New Physiology against Aristotle," the third, "New Meteorology against Aristotle."[10]

References to medieval authors are rarer. Thomas Aquinas is twice quoted (I, 1 p. 3 and II, 3 p. 64) and his ingenuity and scholarship are highly praised. Yet Gilbert adds that Thomas did not experiment and consequently committed errors. A few Arabian authors are mentioned, but for the most part their opinions are attacked.[11]

Almost the same holds of the authors of the modern era. Gilbert does not seem to have known the humanists very well. Among modern scholars cited most frequently are the philosopher-physician Fracastoro, the mathematician and physician Cardanus, the philologist and physician Scaliger, and the learned compiler of curiosities, Giambattista Porta. The first three authors were among the most famous scholars of the late Renaissance. Nearly always Gilbert derides all four of them, Fracastoro because of his belief in "sympathy," the others because of their credulity and superstition. Gilbert—he was physician in ordinary to Queen Elizabeth—wrote two chapters (I, 14 and 15) on the medical effects of iron. There he proves to be familiar with modern medical literature, but practically all authors cited are refuted. He vehe-

[10] Thales, Empedocles, Anaxagoras, Pythagoreans, Plato praised V, 1; Plato attacked p 61; Aristotle: his importance admitted (pref. about the end), his (and Galen's) opinions on iron approved, p. 39; Hippocrates praised because he did not advocate the doctrine of the four elements *De Mundo*, p. 5, attacked *De Magnete* p. 35; Galen criticized, p. 35 and 62, his importance admitted, pref. about the end; Strabo, Ptolemy, Tacitus, and Pliny the Elder quoted on iron mines p. 25; Pliny the Elder (on glass-making) attacked, p. 112.

[11] Avicenna is quoted on meteorites, p. 26; the medical opinions of Avicenna, Razes (= Abu Bekr al Rasi), and unnamed Arabian physicians attacked, p. 34f.; the alchemists Geber and Gilgil Mauretanus attacked, p. 19.

mently attacks Paracelsus, who among the physicians was the first to rebel against the authority of Aristotle and Galen, and he twice mentions (pp. 34 f.) the eminent and empirical-minded anatomist Fallopius without bringing him into any prominence. Gilbert's personal medical opinions are remarkably sound and free of superstition. Contemporary astronomical literature is well known to him (*De Mundo* II, 10 and 20) and Copernicus is highly praised in *De Magnete* (VI, 3). In the preface to *De Magnete*, written by Gilbert's friend Wright, the heliocentric theory is defended at length against scientific and religious objections.[12]

More may be learned of the origin of Gilbert's ideas from the references lacking than from those he gives. Among ancient authors three are conspicuous by their absence in *De Magnete:* Euclid, who is most important for the development of geometrical knowledge in the fifteenth and sixteenth centuries; Archimedes, who greatly influenced mechanics in the same period; and Vitruvius, who is the main source of knowledge in the field of ancient engineering. The three omissions show that Gilbert was not concerned with the mathematical literature of the period, that he was not interested in mechanics, and that he had connections neither with the humanists nor the architects of the Renaissance, who often quoted Vitruvius. With artists, presumably, Gilbert did not have any contacts at all. He could have found real experiments in the papers of the Italian artist-engineers (Brunelleschi, Ghiberti, Leonardo), which, however, were not yet printed. He never mentions Biringuccio either, who belonged with the architects of the Renaissance. Biringuccio's work *Della Pirotechnia,* printed in 1540, treats metallurgy quite empirically and by experiments, but still discusses the magnet in a rather superstitious way.

The omission of one more group of authors is instructive. Gilbert's opposition to belief in books and authorities and his pride

[12] Nicolaus Cusanus ("not to be despised"), p. 64; Marsilius Ficinus, p. 3 ("ruminates ancient opinions") and p. 16; Fracastoro *De Sympathia* (1545), mentioned, pp. 5, 9, 110, 113; his theory of planetary movements (given in his *Homocentricorum seu de Stellis Liber*) discussed in *De Mundo* II, 10; Cardanus's *De Subtilitate* (1552) attacked, pp. 5, 27, 37, 42, 63, 107, 110, 169; Scaliger's *Exercitationes Esotericae* (1557) attacked, pp. 5, 27, 37, 42, 63, 107, 110, 169; Porta's *Magia Naturalis* (1589) quoted, pp. 6, 24, 63, 137f., 143f., 166ff.; Paracelsus's "shameless charlatanry" attacked, p. 93, his merits admitted but Paracelsists attacked, *De Mundo* p. 7; the Antiparacelsist *Thomas Erastus* quoted, pp. 3 and 23. Tycho Brahe (on the coordinates of the Polaris) referred to, p. 174.

in the novelty of his ideas, are greatly reminiscent of Bernardino Telesio. Telesio was the first among the scholars of the Renaissance to oppose his "own principles" to Aristotelian natural philosophy (*De Rerum Natura iuxta propria Principia,* 1565 and 1570). Actually the influence of Telesio appears a few years after *De Magnete* in the works of Bacon, in which the anti-Aristotelian rebellion is carried on with even greater impetus. Gilbert, however, neither mentions Telesio nor seems to have known his work. The case of Telesio's pupil Patrizzi is somewhat different. Patrizzi always attacks Aristotle but is not much of a champion of originality: he likes quoting Plato and the authorities of occult science too well. He was known to Gilbert and is twice quoted in *De Mundo* (II, 2, p. 118 and II, 10, p. 151). Both times, however, statements of Patrizzi—on the shape of the globe and on the cause of the motions of the stars—are rejected. In *De Magnete* also both content and wording of the Neoplatonic chapter on universal animation (V, 12) obviously are influenced by Patrizzi, although he is not even mentioned.[13] Campanella and Giordano Bruno are also intellectually related to Telesio. Both attacked Aristotle and rejected the humanistic veneration of books with the same vehemence. Yet they are never mentioned in Gilbert. Bruno lived in England from 1583 to 1585; it would have been easy, therefore, for our author to make contact with him.

Gilbert's ideas—he describes, as we have seen, parts of *De Mundo* as *Physiologia nova contra Aristotelem, Nova Meteorologia contra Aristotelem*—belong to the same intellectual current as those of Telesio, Patrizzi, Campanella, and Bruno. Modern technology and modern economy had changed civilization too thoroughly for the Scholastic belief in Aristotle or the humanistic veneration of antiquity to endure. Telesio, Patrizzi, Campanella, and Bruno, however, were metaphysicians, not experimentalists, though Telesio and Campanella, theoretically at least, emphasized the importance of experience. It is rather instructive to realize that

[13] Patrizzi's main work *Nova de Universis Philosophia* appeared in Venice, 1591. We quote, however, from the second edition, Venice, 1593. The part *Panpsychia,* book 4 refers to the Presocratics, Plato, the Neoplatonists, the Egyptians and Chaldeans, and to Zoroaster, Hermes, and Orpheus; it stresses the fact that stars do not need organs, though they have souls; it three times (fol. 55 col. 2 and 3) calls Aristotle's philosophy a "monstrum," because in his doctrine the whole universe is animated except for the earth. Quite the same theses and references are repeated in *De Magnete* V, 12 and even the term "monstrum" appears there (p. 209).

three of these philosophers exerted no influence at all on Gilbert and only Patrizzi contributed a few Neoplatonic ideas to his philosophy. In a sociological analysis the young experimental science of the early seventeenth century and the antidogmatic but fantastic metaphysics of the late Renaissance might prove to be connected: in both the same rebellion of the nascent modern society against the antiquated erudition and authorities of the past manifests itself. Yet the natural philosophy of the late Renaissance was the older brother of experimental science, not its father. The experimental method did not and could not have descended from the metaphysical ideas of the natural philosophers. We have to look elsewhere and in other social ranks for its immediate predecessors.

Among all the scholars quoted by Gilbert there is one who really did influence his investigation and method a great deal, although he does not at all emphasize this indebtedness. This is the medieval nobleman Pierre de Maricourt, who in 1269 wrote a short but remarkable account of his magnetic experiments. About his life almost nothing is known. Written copies of his letter on magnetism were circulated until the sixteenth century, when it was printed under the title *Petri Peregrini Maricurtensis De Magnete, seu Rota perpetui motus libellus,* Augsburgi, 1558. Gilbert mentions Petrus Peregrinus five times in *De Magnete* and once in *De Mundo.*[14]

The first reference is in the first chapter of *De Magnete* which compiles the opinions on magnetism of the authors of the past. There (p. 5) Gilbert says: "About 200 years before Fracastoro there is a short work, sufficiently learned considering the period, under the name of a certain Petrus Peregrinus, which many think to have originated in the opinions of the Englishman Roger Bacon of Oxford. From that Johannes Taysner of Hainolt excerpted a booklet and published it as a new one."[15] Twice (III, 1 p. 116 and IV, 1 p. 153) Petrus is mentioned among the advocates of the erroneous opinion that "the magnetic needle is attracted by the celestial pole." In a short chapter (II, 35) Gilbert vehemently

[14] On Pierre and his letter *cf.* Silvanus P. Thompson: *Petrus Peregrinus de Maricourt and his Epistola de Magnete, Proc. Brit. Acad.* vol. 2 (1905/6), pp. 377–408, and Erhard Schlund: *Archivum Franciscanum Historicum* vol. 4 (1911) and vol. 5 (1912). The letter on magnetism is reprinted in G. Hellmann: *Rara Magnetica* (*Neudrucke etc.*) Berlin, 1898.—On the origin of Pierre's scientific method *cf.* below § 8.

[15] As a matter of fact Roger Bacon depends more on Pierre than Pierre on Bacon.—Taysner's plagiarism was printed Coloniae 1562.

rejects the perpetual motion engines of Cardanus, Antonius de Fantis, Petrus Peregrinus, and Johannes Taysner. And, finally, in *De Magnete* VI, 4 (p. 223) and *De Mundo* II, 7 (p. 13) he criticizes Pierre's story of the always rotating *terrella* (*cf.* §2, above). Except for the first passage, which, however, is rather general and rather tepid, Gilbert always differs with and criticizes the opinions of Pierre de Maricourt.

But in fact he owes more to Pierre than his words indicate. Pierre already knew (Chap. 6) that unlike poles attract, like ones repel one another. He knew (Chap. 9) that, when a magnet is divided, the pieces become new magnets with new poles. But Gilbert's knowledge of these facts need not have been taken over directly from the medieval experimentalist. The case is different with the spherical shape of the magnets. This shape is not a matter of course, but is, from the modern point of view, rather inexpedient. Pierre uses spherical loadstones, and the complicated way of determining the magnetic poles of the sphere—short pieces of iron wire are put on them and meridians are drawn with chalk until they intersect—is so completely identical in both authors (Pierre, Chap. 4, Gilbert I, 3, p. 12 f.) that literary influence cannot be doubted. Gilbert is indebted to the outstanding medieval experimentalist as well for one of his experimental devices. Pierre (Chap. 5–7) had already made his loadstones float on water by means of wooden vessels. The cork pieces which are used by Gilbert of course were not yet known to him.

5. Up to this point we have not been able to give many positive contributions in answer to our main question. We have traced numerous authors to whom Gilbert was not indebted for his scientific method and only one—Pierre de Maricourt—to whom he was. The origins of his experimental technique and his scientific criticism are almost as enigmatic as they were before we started collecting his quotations. But we may have proceeded incorrectly. It was wrong, in fact, to look for his intellectual predecessors among scholars and philosophers. One has but to turn over the leaves of *De Magnete* in order to realize that he was interested in unscholarlike people and non-scholastic subjects too. Of the 240 pages of the book only 97 (40%) explain physical experiments. On the other hand 60 pages (25%) deal with nautical instruments and navigation, 25 pages (10%) with mining, melting, and fashioning of iron. The rest discusses astronomical questions (25 pp.), the

opinions of numerous authors (18 pp.), the terrestrial globe as a magnet (11 pp.), and the medical effects of iron (4 pp.). Obviously *De Magnete* differs a great deal from a modern textbook on magnetism. The very first printed book on experimental physics deals so extensively with practical problems, that in some respects it is nearer to a technological than to a physical work of our time. And this gives the clue to the solution of our problem.

We may discuss first Gilbert's interest in mining and metallurgy. The literature on the subject is well known to him. George Agricola, the best known sixteenth century author in this field, is quoted most frequently. Gilbert esteems him highly but corrects errors uncritically taken over by Agricola from antiquity. Not less than three chapters of *De Magnete* (I, 2, 7, and 8) give extensive accounts of the distribution of iron in the world, describe the various ores, and quote ancient, Arabian, and modern authors on the subject.[16] Iron-manufacturing also is discussed at length (I, 7). Gilbert reports (p. 23) on the manufacturing of cast iron, wrought iron, and steel in Styria and Spain, he refers to the description of iron-foundries in Porta's *Magia Naturalis,* and gives (p. 24) a list, eleven lines long, of iron devices. It contains among other things various kinds of guns, "the plague of mankind," and ends with a hint at other "numerous devices unknown to Latins." His reports on England are most interesting, as they are obviously based on

[16] The books of Agricola (1490–1555) on mining and metallurgy are still the best source of knowledge on this branch of technology in the 16th century. Gilbert (I, 1 p. 2) calls him "most outstanding in science," but regrets that he took over the ancient stories of antimagnetic effects of garlic and diamond. He rejects (I, 38 p. 110) Agricola's statement that the magnet is useful in glass-manufacturing and reproaches Agricola for being influenced on this point by the "ignorant philosophy" of Pliny the Elder. Of course Gilbert knows that glass is not attracted by magnets. He approves (I, 7 p. 19) Agricola's chemical opinion that iron is composed of earth and water. Agricola and other—unnamed—"learned metallurgists" are referred to (I, 2 p. 10) on occurrences of iron-ore in Germany and Bohemia. On a special kind of iron-ore the opponent to Paracelsus, Thomas Erastus, is given as literary informant (I, 7 p. 23). *De Magnete* I, 8 quotes Strabo, Ptolemy, Tacitus, and Pliny on iron-mines in various parts of Europe and emphasizes that iron is the most frequently occurring mineral, as "every expert on metallurgy and chemistry" can confirm. Again Agricola is given as a reference for the occurrence and working of meadow-ore (p. 26). "As some authors write," (obviously Spanish cosmographers or mariners), there is iron in the West Indies too, "but Spaniards are looking for gold only." The chapter ends with a report on iron meteorites and quotes on that subject Avicenna, Scaliger, and Cardanus.

personal experience. He tells (I, 2 p. 11) that "newly" in an English mine, owned by the gentleman Adrian Gilbert, magnetic iron ore was found.[17] He reports (I, 7 p. 23) on the handling of iron in English gun foundries. And he knows (I, 8 p. 26) that English clay always contains iron and that, if bricks are baked in open kilns, "which are called *clampa* with us," the bricks next to the fire show "ferruginous vitrification."

Gilbert is also familiar with forging. In a chapter dealing with magnetic experiments (I, 11 p. 29) he describes how he himself manufactures the wrought iron he needs for his experiments, and adds: "out of that the hammersmiths (*fabri*) form quadrangular pieces but mostly ingots (*bacillas*) which are bought by merchants and blacksmiths (*ferrarii*) and out of which various devices are manufactured in the workshops (*officinis*)." In a chapter (III, 12) which explains how iron is magnetized by the magnetic field of the earth he even gives a large woodcut of a smithy with furnace, bellows, anvil, and tools.

That very woodcut, which would be impossible in a modern textbook on magnetism, illustrates the intimate connection of Gilbert's theoretical investigation with practical metallurgy. Moreover, we must not forget that Gilbert did not live in the period of tradition-bound medieval handicraft. The mining and metallurgy he is interested in is the mining and metallurgy of rapidly advancing early capitalism. As we know from Agricola, hauling engines, stamping mills, ventilators, and tracks for the dogs came into use in mining during the sixteenth century. In the same period the introduction of the blast furnace revolutionized the whole technique of iron manufacture. English mining and English metallurgy participated in that development.[18] Since the miners and foundrymen of the period belonged to the lower ranks of society and were uneducated we know neither their names nor their ideas. Yet we cannot doubt that many of them, stimulated to improvements by economic competition, were wont to try new techniques and to observe natural processes. Technology could not have progressed so rapidly if the laborers in the manner of the medieval guilds had simply

[17] The owner was no relation of the author. *Cf.* the family-tree in Silvanus B. Thompson: *The Family and Arms of Gilbert of Colchester,* Trans. Essex Archaeol. Soc., vol. 9, new series (1906) p. 211.

[18] *Cf.* Ludwig Beck: *Geschichte des Eisens,* Braunschweig 1893–95, vol. 2, pp. 879–97.

clung to the traditional working-processes of the past. Obviously, among such manual laborers there were experimentalists, though experimentalists with practical aims only and without theoretical knowledge. With their ranks Gilbert must have had many contacts. By a lucky accident we are even able to prove that he must have himself descended into an iron mine. Once (III, 2 p. 119 f.) he tells how he verified the hypothesis that the direction of magnetism in magnetic iron ore is induced by the earth. He says:

> We had a twenty pounds' heavy loadstone dug and hauled out after having first observed and marked its ends in its vein. Then we put the stone in a wooden tub on water, so that it could turn freely. Immediately the surface which had looked to the North in the mine turned itself to the North on the water.

It is almost symbolic that Gilbert performed a laboratory experiment just after having left a pit and talked to miners. Of course Gilbert's experiments were not plain copies of the trials of the miners and foundrymen. But his spirit of observing and experimenting was taken over not from scholars but from manual workers. Sometimes, however, even his experiments simply repeated the working processes of contemporary iron manufacture. In three chapters of *De Magnete* (I, 9–11) he describes magnetic experiments with iron ore and wrought iron: he makes pieces of ore and iron float on water, he suspends them by threads, and has them attracted by magnets; but first he heats the ore for hours in a furnace and melts it; then he hammers the product, puts it into a second furnace and so on. All this is described, not as a mere preparation, but as a part of the experiments themselves. At least a part of his laboratory must have looked like a smithy.

6. Navigation and nautical instruments play an even greater part in *De Magnete* than mining and metallurgy. About 32 pages (13%) of the book are dedicated to nautical instruments, about 28 (12%) to general navigation. Already at the very beginning of *De Magnete,* in Wright's preface, geographic discoveries and circumnavigations of the globe are mentioned. In his survey of previous writers on magnetism (I, 1 p. 4) Gilbert reports (erroneously) the history of the invention of the compass and remarks that "no invention of human arts has ever been of greater use to mankind." He mentions Sebastian Cabot as the discoverer of magnetic declination and gives (p. 7) the names of four men "who

have observed the variety of magnetic declination on long voyages'': Thomas Hariot, Robert Hues, Edward Wright, and Abraham Kendall.[19] Gilbert proves to be familiar with mariners also in a chapter on the terrestrial globe. There (I, 17 p. 39) he gives numerical statements on the depth of the ocean according to the soundings of the mariners. He must have been told of their results by personal friends.[20]

The full extent of his nautical knowledge appears in the fourth book of *De Magnete* which deals with magnetic declination. Gilbert knows (IV, 1 p. 152) that declination differs at different places and gives its amount for places dispersed over all oceans and continents.[21] The remarkably wide range of his statements proves his familiarity with the reports of the English, Spanish, Portuguese, and Dutch navigators and the books of the learned cosmographers of the period. Moreover he mentions (IV, 5 and 10) that declination is great in high latitudes and that it is not influenced by the iron mines of the island of Elba in the Mediterranean. He knows

[19] Since Gilbert's authorities on navigation are characteristic of the social soil from which modern natural science has sprung, their activities and occupations are important. The mathematician and astronomer Hariot or Harriot (1560–1621) who was mathematical tutor to Sir Walter Raleigh as a young man, was sent by him as a surveyor to Virginia, and came back to England later. He published a report on Virginia, and mathematical works. The mathematician Robert Hues (1553–1632) accompanied Thomas Cavendish on his circumnavigation of the globe and published a *Tractatus de Globis et eorum Usu,* London 1594, dedicated to Sir Walter Raleigh. The mathematician Edward Wright (1558–1615) accompanied the Earl of Cumberland on his voyage to the Azores. He was lecturer on navigation to the East India Company. In his book *Certaine Errors in Navigation,* London 1599, he introduced the cartographic projection that usually is ascribed to Mercator. Abraham Kendal or Kendall is the only non-scholar among the four men. He was sailing-master of Sir Robert Dudley's ship the Bear and later joined Drake's last expedition (*cf. The Oxford Dictionary of National Biography* and the Chiswick Press translation of *De Magnete,* London 1900, notes p. 19). Wright wrote the second preface to *De Magnete.* Most probably the three other men also were personal friends of Gilbert (*cf.* footnote 22 below).

[20] He states that the depth of the ocean reaches one mile at a few places only and generally is no more than 50 to 100 fathoms. As the greatest depth of mines he gives 400 to 500 fathoms, as the diameter of the earth 6,872 miles.

[21] P. 153f. East coast of the Atlantic from Guinea to Norway, West coast from Florida to Cape Race in New Foundland; p. 161 Azores; p. 163f. London; p. 167 North Cape in Norway, Corvo in the Azores, Plymouth; p. 178f. on the equator and in the South Atlantic (St. Helena); pp. 179–182 Nova Zembla (from Dutch observations), South Pacific, Mediterranean, Indian Ocean.

(IV, 8 p. 165 f.) that the Portuguese royal cosmographer Pedro Nuñes (*Tratado da Sphera,* Lisboa, 1537) disregards declination entirely and that the Spanish historian Pedro de Medina (*Arte de Navegar,* Valladolid 1545) is wrong on it. He complains of the inexactness of most mariners in determining declination and warns especially of the reports of Portuguese navigators on their voyages to the East Indies. He knows that the Portuguese mariner Roderigos de Lagos, the Spanish mariner Diego de Alfonso, the Dutchmen, and "the experienced Englishman" Abraham Kendall contradict each other in their numerical statements (IV, 13 p. 177 f).[22] Since determination of geographic longitude was a difficult and, consequently, an often discussed problem at that period, he tries to solve it by means of the declination of the magnetic needle. He mentions (IV, 9 p. 167) that the learned compiler of curiosities Giambattista Porta (*Magia Naturalis,* 1589), the Venetian geographer Livio Sanuto (*Geografia,* 1588) and the mathematician Giambattista Benedetto give wrong solutions of the problem, since declination does not vary proportionally with the distance on the surface of the earth, as had been assumed by them. In the end he quotes the correct solution of Simon Stevin, the eminent Dutch expert in military engineering, navigation and book-keeping.[23]

Gilbert is familiar with the astronomical aids to navigation too. He knows how geographic latitude is determined astronomically, even takes into account atmospheric refraction, and gives a long list of bright stars with their declinations and right ascensions for the practical use of navigators (IV, 12 p. 174f.).

Gilbert got his nautical knowledge not from reading only. Again, as with the miners, an occasional mention in *De Magnete*

[22] The sailing-master Kendall (*cf.* footnote 19) did not publish any book. Since Gilbert is familiar with his experiences, he must have known him personally.

[23] The (antiquated) solution is: the declinations at the various places of the surface of the earth have to be listed at first and then the geographic position of the ship can be determined by comparing observed declination with the list. Stevin's paper (*De Havenvinding,* Leyden 1599) is reprinted in G. Hellmann, *Rara Magnetica,* Berlin 1899. Gilbert does not quote the original paper but its Latin translation by Hugo Grotius (the elder) *Portuum Investigandorum Ratio,* 1599. It was in the same year translated as well into English by Gilbert's friend, Edward Wright (*The Havenfinding Art,* London 1599) and into French (*Le trouve Port,* Leyden 1599). The four publications in one year, three vernacular, one Latin, illustrate rather well the rapid development in scientific navigation at this period and the kind of people Gilbert was in touch with. He quotes Stevin just one year after his paper had appeared. In this period this is remarkable.

reveals the personal contacts of the author. Once (III, 1 p. 117f.) Gilbert explains that the compass works under all latitudes from the equator up to the 70th and 80th degree N.L., and adds: "This the most famous captains and also very many of the more intelligent sailors confirm to us. This our most famous Neptunus Francis Drake, and the other circumnavigator of the globe, Thomas Cavendish, have told and confirmed to me." Obviously he is proud of the friendship of the two great circumnavigators who by their naval victories over the Spaniards—and by their successful privateering—had access to the court of Queen Elizabeth. Cavendish was a gentleman by birth, Sir Francis Drake was knighted because of his naval success: the names of the ordinary master mariners and helmsmen Gilbert had contact with are not given by him.[24]

At the end of the passage just quoted (III, 1 p. 118) Gilbert states that the compass works badly only when the needle has rusted or when the point on which it turns has got blunt. This leads us to his interest in nautical instruments. The measuring instruments described at length in *De Magnete* have already been discussed, and it has been mentioned that they are less new than the reader of Gilbert's description would assume.[25] After the publication of *De Magnete* Gilbert was still engaged in improving his instruments and making propaganda for them. One year before Gilbert's death a certain M. Blundeville published a booklet *Theorique of the Seven Planets,* London, 1602. It is written in English and contains as an appendix "the making description and use of two most ingenious and necessarie Instruments for Seamen. . . . First invented by my good friend, Master Doctor Gilbert. . . ." Obviously Gilbert had suggested the publication in English. The two instruments are the nomogram of *De Magnete,* which is supposed to make possible the determination of geographic latitude, and a somewhat more simplified inclinometer than the one in *De Magnete.*[26] As this improvement shows, Gilbert does not

[24] Gilbert himself in the quotation just given distinguishes "illustrissimi naucleri" and "nautae etiam sagaciores plurimi" among his authorities. The sailing master Abraham Kendall (*cf.* footnotes 19 and 22) was personally acquainted with him. Edward Wright was his friend and so probably were Thomas Harriot and Robert Hues (*cf.* footnote 19). These three men, however, were academically trained mathematicians who had intimate relations with navigators and navigation.

[25] § 1, footnote 2.

[26] Blundeville is one more of the friends of Gilbert. He wrote popular scientific books in English for gentlemen. Besides the quoted work he published treatises on

deal with instruments as a mere theorist, but is familiar with the practical demands master-mariners make. He realizes (*De Magnete* IV, 12 p. 172) that in navigation simply built instruments are necessary which can be handled in spite of the rolling of the ship, and he invents and draws nomograms because he feels complicated calculations and "the exercises of mathematical genius" to be out of place on shipboard. On the method of preparing, magnetizing, and balancing the needle of the compass he gives a few practical hints (III, 17 p. 147 f.). He discusses at length (IV, 8 p. 165 f.) the various types of compasses that are used by the sailors of the various European nations. This chapter, however, is based on statements of Robert Norman without mentioning his name.

7. Norman's influence on Gilbert's investigation is so important that it must be discussed in greater detail. Gilbert himself does not emphasize it at all, but rather hides it. In the first chapter, after mentioning Wright and his friends, Gilbert goes on (p. 7 f.): "Others invented and made public magnetic instruments and expedient methods of observation, necessary to navigators and long-distance travellers, *e.g.*, William Borough in his booklet on the Declination of the Compass, William Barlow in his Supplement,[27] and Robert Norman in his New Attractive." He adds that Norman, "an expert mariner and ingenious artificer," discovered the dip of the needle. A second time also Norman is quoted with approval. There (IV, 6, p. 161f.) Gilbert explains that the adjusting of the magnetic needle with the meridian is not effected by attraction but by some "disposing and turning faculty" of the earth, and adds that this was stressed by Norman as the first.

horsemanship, on Aristotelian logic, on map-making, on morals, and on counsellors of princes. The sub-title of his *Theorique of the seven Planets* illustrates rather well which social ranks outside the universities were interested in astronomy at Gilbert's time. It reads: *A Booke most necessarie for all Gentlemen that are desirous to be skillful in Astronomie and for all Pilots and Sea-men or any others that love to serve the Prince on the Sea or by the Sea to travell into forraine Countries.* This means that astronomical papers—if they were written in English—were of interest to over-sea-traders and ship-owners, their master-mariners and helmsmen, and the gentlemen in the Royal Navy. Blundeville's booklet is based not only on Ptolemy but also on the ephemerides of Peurbach, Copernicus, and his followers Reinhold and Mestlin.

[27] Barlow was the son of a bishop and himself a clergyman, and was interested in navigation, though he had never gone to sea. He published among other papers *The Navigators Supply,* London, 1597. He was a personal friend of Gilbert. Cf. Gilbert's letter to him, published in Barlow, *A Brief Discovery of the Idle Animadversions of Mark Ridle,* London, 1618.

Then he describes at length and illustrates by a woodcut an experiment which is supposed to prove the explanation given.[28] The experiment in every detail (and its incorrect interpretation) is borrowed from Norman's book. Twice more (I, 1 p. 5 and IV, 1 p. 153) Norman is mentioned in three words as the author who suggested the name "point respective" for the place that all magnetic needles point to, instead of "point attractive." Strangely enough, three of the four quotations refer to an opinion in which Norman is wrong. If we wish to learn what Gilbert actually owes to him, we have to examine Norman's treatise.[29]

Norman was a retired mariner who had turned to compass-making. That can be inferred from his booklet, which is the only source available on his life. The booklet itself begins with a few mineralogical remarks on magnetic iron ore, and reproduces a story of Paracelsus on loadstones which can be strengthened to such a degree by making them red-hot so that they can draw nails out of a wall. It is the same story which incites Gilbert to abuse Paracelsus as a shameless charlatan (*De Magnete,* p. 93). Norman, however, believes it. It is more important that Norman's very first chapter describes experiments in which magnets are suspended by threads and made to float on water.[29a] The second chapter discusses earth-magnetism. Norman does not believe that it can be explained by loadstones at the North Pole of the earth, because he knows that the iron mines at Elba do not deflect the magnetic needle—a statement simply taken over by Gilbert. Then Norman discusses (chap. 3) the dip of the magnetic needle "not

[28] He makes a magnetic needle float in water by means of a piece of cork and carefully sees to it that it is completely submerged; from the fact that the needle adjusts itself with the direction of earth-magnetism but is not drawn to the rim of the vessel he concludes that there is no attraction. He (and Norman) forget that the needle has two opposite poles which are drawn to opposite directions.

[29] *The Newe Attractive, Containing a short discourse of the Magnes or Lodestone and amongest other his vertues, of a newe discovered secret and subtil propertie concernyng the Declinyng of the Needle touched therewith under the plaine of the Horizon. Now first founde by Robert Norman Hydrographer. Hereunto are annexed certaine necessarie rules for the art of Navigation by the same R.N.,* London, 1581. The book, reprinted in 1585, 1592, 1596, 1614, and 1720, has become a bibliographical rarity. G. Hellmann, *Rara Magnetica,* Berlin 1898 gives a reprint of the 1720 edition. The preface, the introductory poems, and the astronomical tables are not reproduced by him. We quote from the extremely rare second edition, London, 1592.

[29a] Norman did this by means of small pieces of cork. It is to be remembered that these new experimental devices were simply taken over by Gilbert in *De Magnete.*

before having heard nor read of any such matter," and describes (chap. 4) and illustrates by a wood-cut the very first inclinometer.[30] The descriptions of two outstanding and most carefully performed experiments follow, both taken over by Gilbert. The first (chap. 5) proves by means of a gold balance that magnetism is imponderable; this is experimentally and theoretically entirely correct. The second (chap. 6) has been mentioned above (footnote 28); it is meant to prove that the earth does not attract but only turns the magnetic needle. It is illustrated by a woodcut, is even more carefully performed than in Gilbert—Norman stresses that any current of air must be avoided—but its theoretical interpretation is wrong, just as it is with Gilbert. The same chapter (6) introduces the term "point respective" which we have already mentioned.

The rest of the book does not contain experiments. Norman discusses (chap. 7) how the "point respective" might be determined by comparing magnetic needles at different places on the earth. As a simple mariner and instrument-maker he is unable, so he confesses (chap. 8), to explain the cause of terrestrial magnetism. "I will not offer," he says modestly, "to dispute with the Logitians in so many pointes as here they might seeme to overreach me in Naturall causes." So he restricts himself to a reference to "God in his omnipotent providence." He discusses (chap. 9) magnetic declination and its diversity at different places, stressing—again we remember Gilbert—that there is no "equal proportion" in it, as some navigators had believed who, "notwithstanding their travells mostley have *more followed their Bookes than experience* in this matter." He himself refers to the "18 or 20 years that I have travelled the Seas." He complains that most mariners have but confused ideas on declination because of lack of suitable instruments: "wherefore I have devised one very necessarie." The last chapter (10) discusses the different types of compasses in various countries and is the source of the corresponding chapter in

[30] As a matter of fact the dip had been observed before, though less exactly, by the German physician Georg Hartmann. Hartmann's unpublished letter (1544) to Duke Albert of Prussia on his discovery, is reprinted by Hellmann, *loc. cit.* By Norman the dip always is called "declination," whereas magnetic declination is called "variation." This terminology also was taken over by Gilbert. Gilbert's inclinometer is a mere copy of Norman's instrument, but Norman proves to be the more experienced instrument-maker. *E.g.* he makes the bearings of the needle's axle of glass. Gilbert neglects that excellent detail.

De Magnete (IV, 8). It follows a second part containing astronomical tables for the use of navigators.

We have already become acquainted with the empirical temper of this simple instrument-maker who, no less than Gilbert, Francis Bacon, and Galileo, prefers observation to books. His intellectual attitude is expressed even more clearly in the remarkable preface to the book. It is addressed "to the Right Worshipfull, M. William Borough, Esquire, Comptroller of her Maiesties Navie." It starts with the anecdote of Archimedes who, while taking a bath, discovers the law of buoyancy, runs naked to the street, and shouts —Norman avoids Greek—"I have found it." Norman continues:

> So I (although in other respects and points of learning and knowledge, I will not presume to compare with Archimedes . . . nor with other learned Mathematicians, being myself an unlearned Mathematician) by occasion of my profession, making sundry experiments of the Magnet stone, found at length amongst many other effects this strange and newe propertie of Declining of the Needle: which forgetting or rather neglecting my own nakedness and want of furniture, to set forth the matter, I have heere in simple sorte proposed . . . to the view of the world.

Again he cites an ancient anecdote, the story of Pythagoras and the hecatomb he offered after having discovered his theorem, and continues:

> So that we see these men . . . being carried and overcome *with the incredible delight* conceived of their own devices and inventions, though, they follow partly the peculiar contentation of their privat fancies, yet they seme chiefly to respect either the glory of god or the furtherance of some publike commoditie. . . . And seing it hath pleased God to make mee the instrument to open this noble secret, that his name might be glorified, and the commoditie of my Country procured thereby, I thought it my dutie to aduenture my credite and make my name the object of slaunderous and carping tongues rather then such a secrete should be concealed and the use thereof unknown.

Continuing, Norman stresses the utility of navigation to his country and again explains his resolution to publish his discovery "to frame as it were a theorike" for the use of mariners, and to describe "whatever I could find by exact triall and perfect experiments."

> Wherin, although I may seeme to have discouered my nakedness and want of eloquence and orderly Methode to utter my conceits withall, I trust the reader will either of his curtesie take all things for good, that is well ment, or of his grauitie, *not regarding the words but the matter,* dissemble my faults, and accept of my paines.

He mentions that he has communicated his findings before publication to a few learned friends and concludes with respectful words to William Borough as "your worships most humble Robert Norman." In his short preface to the reader he emphasizes also that he will "ground his arguments onlye upon experience, reason and demonstrations." "Many and divers ancient Authors, Philosophers and other" have written on the magnet, but he intends to write "contrary to the opinions of all them." This remarkable man who, twenty-five years before Galileo's first publication, speaks of the "incredible delight" of experimental discovery, was a craftsman. At the end of the first edition of his booklet a kind of advertisement was printed, stating that the instruments described "are made by Robert Norman and may be had at his home in Ratclif."[31] When the seamen of the sixteenth century went to sea, they laid the foundation-stone of the British Empire and when they retired and made compasses, of modern experimental science.

The note just quoted refers to Norman's own inclinometer and to two declinometers constructed by the mariner William Borough and described in Borough's *Discourse of the Variation of the Compass or Magneticall Needle,* that in all editions was annexed to Norman's booklet. Borough is mentioned in *De Magnete* (I, 1 p. 7) together with Norman as an inventor of magnetic instruments.[32]

Robert Norman is of great importance for our problem. Except for the Latin erudition, the quotations and polemics, and the metaphysical philosophy of nature, he has everything that is pecu-

[31] Quoted from Hellmann *loc. cit.* The note is omitted in the later editions, presumably because Robert Norman had died.

[32] He was born in 1536, travelled to the White Sea, became Comptroller of the Queens Navy in 1583, and was commander of an English ship in the Armada battle of 1588. Socially he belongs to a higher rank of mariners than Norman and is superior to him in education. In the preface to his *Discourse* he urgently recommends mathematics to the seamen, emphasizing that there are sufficient books on that subject written in English. He mentions "Vitriuius" (*sic*), Albert Duerer, and the ship builder Mathew Baker, as outstanding representatives of the "mechanicall sciences" to which also navigation belongs. He praises the good maps of Abraham Ortelius and criticizes the bad ones of the Paris professor Postillus. Ortelius (1527–98), the most famous map-maker of the period, came from handicraft, but became geographer to Philip II of Spain. Guillaume Postel (1505–81) is a learned polyhistor. The navigator Borough with his relations to superior handicraft on the one hand, to practical astronomy, cartography, and a bit of mathematics on the other, illustrates rather well the soil out of which Gilbert's work has grown.

liar to Gilbert. Norman as well as Gilbert proceeds by experiment and, "not regarding the words but the matter," bases his statements on experience rather than on books. Moreover, the measuring-instruments and the details of the experimental technique, the most exact experiments, and many single empirical statements of *De Magnete* are already contained in his booklet. It is true that the compass-maker Norman is a craftsman and Gilbert a scholar; but Norman already feels "incredible delight" at his discoveries and is interested in knowledge for its own sake: neither his experiment on the ponderability of magnetism nor his dilemma concerning "point respective" or "point attractive" has any practical bearing. In things that are farther away from his occupation he is a little less critical than his follower of higher birth: he modestly believes in the story of Paracelsus which is vehemently criticized by Gilbert. On the other hand he is more religious than Gilbert: where Gilbert takes to Neoplatonic theories of universal animation, he retreats to God's impenetrable providence and avoids further explanation. Socially this is the difference between the highly educated scholar of the late Renaissance and the retired mariner. As to scientific value, however, Norman's attitude does not compare at all unfavorably with Gilbert's. Far reaching theories are lacking in his book; but is Gilbert's metaphysics of "distinguished spherical form" that brings about magnetism a useful scientific explanation? The modern scientist may miss it in Norman's paper as little as he does Gilbert's quarrelsome polemics and erudite quotations. By the absence of all these Renaissance paraphernalia the experimenting compass-maker is even nearer than Gilbert to the sober objectivity of modern natural science. Or, if we may put it the other way round: modern science and the modern mind in general are nearer to the experimenting manual workers of early capitalism, in which they had their origin, than to Renaissance humanism, which still influences even Gilbert.

III

8. The last paragraphs have answered our main question. Gilbert's experimental method and his independent attitude towards authorities were derived, not from ancient and contemporary learned literature, but on the one hand from the miners and foundrymen, on the other from the navigators and instrument-makers of the period. Alchemistic experiments probably never

were performed by Gilbert, for he always vehemently attacked the alchemists and derided their attempts to make gold.[33] A rather complete assortment of the sources of his scientific achievements has been given by himself in his discussion of the practical use of the magnetic needle. There (III, 17 p. 147) he explains that by means of the needle the content of iron can be diagnosed in ores. The needle is the main part in the compass, which is, as it were, "the finger of God," and has made possible the Spanish and English circumnavigations of the globe. By means of the magnetic needle veins of iron ore can be discovered, subterranean galleries can be driven in sieges, guns can be pointed at night, territories can be surveyed, and subterranean water-conduits can be constructed.[34]

Altogether, the impression of Gilbert's originality is considerably impaired, when he is confronted with his sources and especially with Norman. In spite of that, Norman is virtually unknown today, whereas Gilbert is counted among the pioneers of natural science. But this proves to be less unjust when the rise of science is viewed as a sociological process. Unfortunately we can only give a sketchy and simplified exposition of that view here and, of necessity, must omit a part of the evidence bearing on the point.[35]

[33] He reproaches them (pref. fol. iij) with "veiling things in darkness and obscurity by means of silly words." They are called (I, 3 p. 19) "cruel masters of metals who torture and harass them by many inventions." They are "delirious" (p. 20) and their doctrine that metals can be changed into gold is "futile" (p. 24).

[34] The considerable part played by military engineering in this enumeration might be striking. We have already met with gun-making in Gilbert's discussion of metallurgy (I, 7 pp. 23f.), have been forced to mention naval warfare and privateering several times, and should meet with military engineering even more frequently if we discussed the investigations of Leonardo da Vinci, Tartaglia, Duerer, and Galileo. Military technology has contributed considerably to the rise of the experimental spirit and natural science. Its influence on Gilbert is comparatively rather slight.

[35] On the following *cf.*: Leonard Olschki, *Geschichte der neusprachlichen wissenschaftlichen Literatur* (vol. 1: *Die Literatur der Technik und der angewandten Wissenschaften vom Mittelalter bis zur Renaissance,* Heidelberg 1918; vol. 2: *Bildung und Wissenschaft im Zeitalter der Renaissance in Italien,* Leipzig-Roma-Firenze-Geneva 1922; vol. 3: *Galilei und seine Zeit,* Halle 1927). All these volumes abound in valuable information on the scholar-literature and the craftsman-literature of the period and contain many sociological aspects. The third volume contains statements, until now scarcely used, on the influence of contemporary technology on Galileo (on the relations of the artists to handicraft, mechanics, military engineering and mathematics *cf.* I, 30–447; on mathematics and mechanics III, 72–110; on Galileo III, 117–469). On a later period *cf.* Robert K. Merton: *Science and Tech-*

From antiquity until about 1600 a sharp dividing-line existed between liberal and mechanical arts, *i.e.*, in the final analysis, between arts needing heads and tongues only and others needing the use of hands also. The former were considered as worthy of well-bred men, the latter were left to lower-class people. Thus the contempt for manual labor tended to exclude experiment (and dissection) from respectable science. The prejudice against manual labor, however, did not prevent the experiments of the alchemists. Alchemy is not an occupation as carpentering, or forging; it is made respectable by the charm of both magic and gold, and even well-bred people may practise it as a hobby. But no respectable scholar who was proud of his position as a representative of the liberal arts even thought of using the methods of the mechanical arts. The case of those craftsmen who aspired to a higher social level is different; they—*e.g.* the Italian artists of the fifteenth century—discussed the social qualifications of manual work again and again, and stressed that they were connected with mathematics, *i.e.* with science.

The social background and the professional conditions of the scholars of the fifteenth and sixteenth centuries can not be discussed here. Nearly all of them had academic degrees and were consequently more or less linked to the universities, or they were humanists. Though several humanists had obtained academic chairs, generally speaking the universities of the period were still dominated by the spirit of Scholasticism. Both the university-scholars and the humanistic literati were accustomed to deal with natural phenomena chiefly in so far as they had been treated before by the authorities of Scholasticism and humanism respectively. On the other hand, since the decay of the guilds and their traditionalism real observation of natural phenomena, and even some experimentation, were to be found among skilled manual workers. Very little, however, is known of their intellectual interests.

nology in the 17th Century, Osiris vol. 4 (1938) pp. 360–630. On the prejudice against manual labor and its intellectual implications *cf.* Edgar Zilsel: *Die Entstehung des Geniebegriffes,* Tuebingen 1926 (pp. 112–130 the humanistic literati, 130–143 the inventors and discoverers, 143–154 the artists and artist-engineers, 310–15 two strata of intellectual activities). On the effects of the prejudice against manual labor on astronomy *cf.* Edgar Zilsel: *Copernicus and Mechanics,* in *Journal of the History of Ideas* vol. I (1940) pp. 113–118. On the effects on anatomy *cf.* Benjamin Farrington: *Vesalio and the Ruin of Ancient Medicine,* in *Modern Quarterly,* London, vol. 1 (1938) pp. 23 ff.

Since they got no education but the practical one in the workshops of their masters, their observations and experiments must have proceeded rather unmethodically.

With the advancement of early capitalistic society two major intellectual developments occurred: on the one hand, by virtue of technological inventions, geographical discoveries, and economic changes, the contrast between present times and the past became so obvious, that in the second half of the sixteenth century rebellion against both Scholasticism and humanism began among the scholars themselves. Representatives of the learned upper ranks, such as Telesio, Patrizzi, Bruno, and Campanella, vehemently attacked Aristotle and the belief in "words," felt enthusiastic about nature and physical experience, but did not experiment. Merely speculative metaphysics was, as it were, the older brother rather than the father of modern experimental science (*cf.* above § 4).

On the other hand, among the ranks of manual laborers a few groups of superior craftsmen formed connections with respectable scholars. During the fifteenth century Italian painters, sculptors and architects had slowly separated from whitewashers, stone-dressers and masons. As the division of labor was still only slightly developed, the same artist usually worked in several fields of art, and often in engineering too. The technical problems of their occupations led them more and more to experimentation. Many of them made contacts with humanistic literati, were told of Vitruvius, Euclid, and Archimedes, and a few of them, such as Brunelleschi (1377–1446), Ghiberti, Leone Battista Alberti, Leonardo da Vinci, Benvenuto Cellini (1500–1571), started writing diaries and papers on their achievements. Biringuccio's treatise on metallurgy, *Della Pirotechnia* (1540), Duerer's two treatises on descriptive geometry and fortification, of 1525 and 1527, in some respect even the papers of Stevin, belong to this literature of the artist-engineers. Another group of superior manual workers were the surgeons, who practised dissection and made contacts on the one hand with artists interested in anatomy, and on the other with medical doctors. Others were the navigators, who formed connections with mathematicians, astronomers, and cosmographers and published treatises on navigation; and, finally, the makers of nautical and of musical instruments. These superior craftsmen were the predecessors of modern experimental science,

though they were not regarded as respectable scientists by contemporary public opinion. So far as papers were composed by them, they were written in the vernacular, not in Latin, and were not read by most of the respectable scholars, even if they were printed. By their colleagues, however, the books, especially those on navigation, were diligently read, as is proved by the five editions of Norman's and Borough's treatises between 1581 and 1614. One has only to recall the humble apologies in Norman's preface to realize the barrier between craftsmen-literature and scholar-literature at the end of the sixteenth century. Experimental science could not have come into existence before this barrier was demolished.

But a few learned authors, very few, comparatively, already showed an understanding of mechanical arts before 1600. The German physician George Agricola published Latin treatises on mining and metallurgy (1544 and 1556); the chaplain at the royal court of Madrid, Peter Martyr, wrote two Latin books on the great geographical discoveries of the period (1511 and 1530); the learned secretary of the Senate of Venice, Ramusio, did the same in Italian (1550); a few Portuguese and Spanish cosmographers, such as Nuñes and Pedro de Medina, wrote mostly vernacular books on navigation. But especially in England, and in the period of Gilbert, similar studies increased. The Oxford B.A. Richard Hakluyt (1552–1616) edited Peter Martyr and published his own widely read books on the great English voyages and discoveries; the prebendary of Winchester, William Barlowe, wrote an English treatise on navigation (1597). The East India Company engaged the Cambridge graduate William Wright as a lecturer on navigation to their master-mariners. Wright and two more mathematicians, the Oxford graduates Thomas Harriot and Robert Hues, published Latin and English books in the same field (1588, 1594, 1599).

All these half-technical, half-learned activities show that some branches of the mechanical arts had become so important economically that they began to engage and to interest a few scholars. But they dealt with metallurgy and mostly with navigation rather than with experiments. The first academically trained scholar who dared to adopt the experimental method from the superior craftsmen and to communicate the results in a book not to helmsmen and mechanics but to the learned public was William Gilbert,

who was a personal friend of most of these English authors. This is Gilbert's achievement in history. It might have been as difficult for the physician in ordinary to Queen Elizabeth to overcome the prejudice against manual labor as it was for the craftsman Norman to raise and answer his theoretical problems—though the two achievements are of a rather different kind. By his understanding of the scientific importance of experiment Gilbert made it—or helped to make it—respectable among the ranks of the educated. A few years later two other scholars likewise followed the method of the superior craftsmen: Francis Bacon, who ranked the great inventors and navigators above the scholars of his period, and Galileo, who started from military engineering.[36]

But we must deal with an objection. Is it true that experimental science could not come into existence so long as liberal and mechanical arts were kept separate by the contempt for manual labor? The fact that Pierre de Maricourt had already performed experiments does not seem to fit in with our exposition. Yet it is significant that Pierre tries to come to terms with the prejudice against manual work. In chapter 2 of his treatise he emphasizes that the investigator of magnetic phenomena must not only know "the nature of things" and celestial motions, but that he must also be "industrious in manual work" (*industriosum in opere manuum*); only by "manual industry" will he be able to correct errors which by mere reason and mathematics cannot be avoided. Obviously Pierre can not stress the value of experimentation without immediately speaking of and defending manual labor.

Pierre, no doubt, was the best experimentalist of the Middle

[36] Galileo had already experimented a few years before *De Magnete* appeared. He became acquainted with Gilbert's book rather soon. We have a letter from Gilbert to William Barlowe, telling that Gilbert met with the Venetian ambassador who brought him a Latin letter of Joannes Franciscus Sagredus. Gilbert continues: "Sagredo is a great Magnetical man and writeth that he has conferred with . . . the Readers of Padua and reported wonderful liking of my booke" (Barlowe, *Magneticall Advertisement,* London 1616). The letter must have been written between 1600 and 1603. Sagredo was a friend of Galileo and later figures as one of the persons of the discourse in Galileo's great dialogues. No doubt, Galileo himself, who was then lecturer on mathematics at the University of Padua, is the "Reader of Padua." Thirty years later, Galileo praises Gilbert highly because of his new and true observations and his habit of examining all statements of authorities by his own experiments. The only thing he misses in him is a little more mathematical knowledge (*Discorsi, Opere,* Edizione nazionale, VII, 432).

Ages.[37] He probably was not a monk but a nobleman and might have been in the Orient as a pilgrim or crusader as his surname *Peregrinus* suggests. In 1269 he took part in the siege of Lucera in Apulia, probably as a kind of military engineer. Most probably he is identical with the *magister Petrus,* the *dominus experimentorum,* often mentioned in Roger Bacon. If this assumption is correct, we know a little of his scientific and social attitude. This Petrus was, as Roger Bacon puts it, keen for the experiences even of "laymen, old women, and country bumpkins"; he was interested in metal founding, the working of gold and silver, mining, arms and military engineering, the chase, surveying, earthworks, the devices of magicians, and the tricks of jugglers.[38] In short, he was interested in all branches of technology that his period had developed and was hampered in his interest by the social prejudices of neither clergy nor nobility. It is significant that in the report of Bacon himself some social scruples still are hinted at ("country bumpkins, old women, jugglers"). Unfortunately we do not know where Petrus' freedom from bias originates. Altogether Pierre's attitude rather confirms than disproves the importance of manual labor and the mechanical arts for the history of science. The extremely rare medieval experimentalists would need an extensive and careful sociological investigation. We have, however, to return to Gilbert.

The social rise of the experimental method from the class of manual laborers to the ranks of university scholars in the early seventeenth century was a decisive event in the history of science. Natural science needs theory and mathematics as well as experiments and observations. Only theoretically educated men with rationally trained intellects were able to supply that other half of its method to science. With Gilbert, however, not much of the superiority of academic training as to the theoretical side of science can be noticed: his general speculations have not proved to be fruitful. It is different with Francis Bacon and Galileo. Bacon's far-reaching ideas on the advancement of learning and scientific coöperation could scarcely have been formed by craftsmen, though they were nothing but generalizations of their own practice. Galileo, on the other hand, joined mathematics with experiment.

Why did Gilbert himself never reckon, why did he come to a

[37] On the following, *cf.* the papers on Petrus Peregrinus quoted in footnote 14.

[38] *Roger Bacon, Opus tertium,* cap. 12, p. 46 (ed. Brewer).

standstill at the first beginnings of quantitative inquiry? Certainly that deficiency is connected with his subject matter. Magnetic and electric processes can be measured only by complicated methods and, in consequence, were first measured almost two hundred years after Gilbert by Coulomb. It is mechanics that was the birthplace of quantitative research, since mechanical processes can be measured comparatively easily. Therefore, authors dealing with mechanics, such as Stevin and Galileo—and centuries before them Archimedes—were the first mathematical physicists. Gilbert on the other hand, as we have seen, is remarkably little interested in mechanics. He almost appears to have been biased against it. In *De Mundo* (II, 10 p. 154) he criticizes mechanistic astronomers who think Ptolemy's spheres to be material. He objects to their hypothesis on the ground that by it the universe is made a great wheelwork and God a mechanic. In the eighteenth century a comparison like this scarcely could have served as an objection to a theory; on the contrary, similar comparisons were commonplaces in the period of mechanistic physics and deism.

Gilbert's pre-mechanical way of thinking and his predilection for a field where measurements are so difficult may be due to his individual characteristics. But they are connected also with the special conditions of his native country. Practically all quantitative investigations in *De Magnete* originate in nautical technique and the work of the compass-maker Norman; Gilbert's interest in iron-making and iron-foundries, on the other hand, does not result in any quantitative inquiry. It was English iron-making and English iron-manufacture, however, that were advancing fast in the late sixteenth century. Instructive inferences can be drawn from the rapid rise of iron-manufacture.[39] Blast-furnaces were introduced in England in the middle of the sixteenth century; the first English wire-mill was built in 1568; iron cannon, which had previously been imported from abroad, began to be exported from England in the same period; in 1581 and 1585 two laws were passed forbidding the construction of more blast-furnaces, in order to prevent devastation of the forests, since blast-furnaces were heated with wood. Certainly these laws show that iron-manufacture was not yet the leading industry of England; wool-trade and cloth-making still were much more important. Altogether, in the six-

[39] Ludwig Beck: *Geschichte des Eisens,* Braunschweig 1893–95, vol. II, pp. 892 and 896.

teenth century iron had not yet reached its dominant part in technology. It still was used in making weapons and simple tools rather than in machinery. And just this point leads us back again to our problem.

The first machines were made of wood and the first mechanical insights, therefore, were acquired from wooden devices—levers, reels, windlasses, inclined planes. There the Italian artist-engineers and Stevin made their studies and found quantitative relations and laws. Galileo, when experimenting on the law of falling bodies, made brass balls roll down an inclined wooden groove. Not before the eighteenth century did iron machines, and not before the nineteenth did metallurgy become subjects of calculation. In the preceding centuries, therefore, predilection for iron prevented rather than promoted application of mathematical methods. Thus England's natural, economic, and social conditions might form, not a sufficient, but a necessary condition for the characteristics of Gilbert's method. When reading *De Magnete* we must never forget that twelve years before its publication English ships and English iron guns annihilated the Spanish Armada, then the most powerful fleet in the world. England, the country of iron mines and advancing navigation, produced the first learned book on experimental physics. It dealt with the mariner's compass, magnets, and iron. And for that very reason it did not introduce mathematical methods into natural science.

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THE HISTORY OF TRADES: ITS RELATION TO SEVENTEENTH-CENTURY THOUGHT

AS SEEN IN BACON, PETTY, EVELYN, AND BOYLE

By Walter E. Houghton, Jr.

The History of Trades has remained unexplored, and in fact forgotten, but there can be no question of its major importance in the minds of such distinguished men as Bacon and Boyle, Petty and Evelyn; and no adequate account of English science or education in the seventeenth century can afford to neglect it. The project was first sketched in *The Advancement of Learning* and then expanded in the *Parasceve* appended to the *Novum Organum;* but in this, as in other cases, there are anticipations of Bacon's thought in the previous century.

In the 1530's we notice a modification of earlier humanist education. Although virtuous action continues to be the primary end of learning, the strain of practical wisdom and the appeal to reason and experience, both implicit in the humanist position, are given greater emphasis. As a result, the observation of man and nature takes its place in a curriculum hitherto limited mainly to classical reading. This is evident in Rabelais and Vives, and makes possible the inclusion of trades as a branch of study. On rainy days, Gargantua and his tutor

> went likewise to see the drawing of metals, or the casting of great ordnance; how the lapidaries did work; as also the goldsmiths and cutters of precious stones. Nor did they omit to visit the alchemists, money-coiners, upholsters, weavers, velvet-workers, watchmakers, looking-glass framers, printers, organists, and other such kind of artificers, and . . . did learn and consider the industry and invention of the trades.[1]

Two years earlier Vives had formulated a similar program in his *De Tradendis Disciplinis* (1531), where, among higher studies, he recommends the arts of cooking, clothing, building, agriculture, and navigation, "wherefore and how they were invented, pursued, developed, preserved, and how they can be applied to our use and profit."[2] In this connection, Vives recognizes an

[1] *Master Francis Rabelais, Five Books of the Lives, Heroic Deeds and Sayings of Gargantua and his Son Pantagruel,* translated into English by Sir Thomas Urquhart . . . and Peter Antony Motteux (1904), I, 73 (in bk. i, ch. 24).

[2] *Vives: On Education. A Translation of the "De Tradendis Disciplinis" by Juan Luis Vives* . . . by Foster Watson (1913), p. 208.

obstacle we shall meet again—the traditional disdain for vulgar knowledge; but learned men, he insists, must "not be ashamed to enter into shops and factories, and to ask questions from craftsmen, and to get to know about the details of their work." (*Ibid.*, 209.) And then follows a passage (*ibid.*, 210) which carries us to the threshold of the History of Trades:

> How much wealth of human wisdom is brought to mankind by those who commit to writing what they have gathered on the subjects of each art from the most experienced therein! . . . By such observation in every walk of life, practical wisdom is increased to an almost incredible degree; those who make such observations should hand them down and let them serve posterity, for whom we ought to care as we do for our own sons.

This sentence shows how the study of trades "applied to use and profit" leads naturally to the description of industrial processes; but the conception of the History of Trades as an organic and systematic work is not in Vives' mind. That appears first in Bacon, and it does so because the study of mechanical arts held a central place in his program for the "reconstruction of the sciences."[3]

I

So much stress has been laid on his inductive method that we sometimes forget Bacon's reiterated claim that "the foundation of this reconstruction must be laid in natural history," though it is to be a natural history "of a new kind and gathered on a new principle."[4] As early as 1605, the outline of the subject in *The Advancement of Learning* reveals his major innovation.[5] In the past, he says, natural history has scarcely gone beyond "nature in course" or the "history of Creatures." "Nature erring or varying" and "nature altered or wrought"—the history of Marvels and the history of Arts—have been "handled so weakly and unprofit-

[3] This article makes no attempt to deal with histories of trades, except in so far as certain histories, like those of Evelyn and Petty, were written as contributions to a History of Trades. It is only that concept as an idea which the article explores.

[4] Preface to the *Magna Instauratio*, in *The Works of Francis Bacon*, ed. J. Spedding, R. L. Ellis, and D. D. Heath (1857–1859), IV, 28. *Cf.* IV, 28–29, 127, 251, 252; V, 211, 507–509. R. F. Jones, *Ancients and Moderns; a Study in the Background of the "Battle of the Books"* (1936), pp. 56–59, places the right emphasis on natural history in Bacon's thought.

[5] *Works*, III, 330–333. *Cf.* also the expanded passage in the *De Augmentis Scientiarum* (1623), in *Works*, IV, 294–299.

ably, as I am moved to note them as deficient." Of the latter, there have been "some collections made of agriculture, and likewise of manual arts; but commonly with a rejection of experiments familiar and vulgar. For it is esteemed a kind of dishonour unto learning to descend to inquiry or meditation upon matters mechanical."[6] Bacon's protest against such social fastidiousness is all the more vigorous because, of the three, the History of Nature Wrought or Mechanical is by far the most important. The paragraph which makes this claim is the central text,[7] and must be quoted in full:

> But if my judgment be of any weight, the use of History Mechanical is of all others the most radical and fundamental towards natural philosophy; such natural philosophy as shall not vanish in the fume of subtle, sublime, or delectable speculation, but such as shall be operative to the endowment and benefit of man's life: for it will not only minister and suggest for the present many ingenious practices in all trades, by a connexion and transferring of the observations of one art to the use of another, when the experiences of several mysteries shall fall under the consideration of one man's mind; but further it will give a more true and real illumination concerning causes and axioms than is hitherto attained. For like as a man's disposition is never well known till he be crossed, nor Proteus ever changed shapes till he was straitened and held fast; so the passages and variations of nature cannot appear so fully in the liberty of nature, as in the trials and vexations of art.

If we follow the implications of this passage we see how closely the History of Trades is related to Bacon's whole cast of thought. It is, for one thing, a particular instance of knowledge directed to the "benefit of man's life" in contrast to scholastic speculation, "cobwebs of learning . . . of no substance or profit."[8] And as the failure of the Schoolmen is laid to their neglect of nature and of the observations of experience (*ibid.*, III, 292), so, we may assume, the success of the mechanical arts is due to the contrary method. This is explicit in the *Novum Organum*, where the vigorous growth of these arts is contrasted with the static or degenerate state of the intellectual sciences. It is because doctrines have been torn up from their proper roots in nature that "the sciences stand where they did" centuries ago; "whereas in the mechanical arts, which are founded on nature and the light of experience, we see the contrary happen, for these . . . are con-

[6] *Cf. Novum Organum*, bk. i, aphorism 120, in *Works*, IV, 106–107, where he calls such fastidiousness "childish and effeminate."

[7] *Works*, III, 332–333.

[8] *The Advancement of Learning*, in *Works*, III, 286.

tinually thriving and growing.'"[9] Elsewhere, the same contrast is used to illustrate another and related axiom of the advancement of learning, the rejection of authority. "The overmuch credit that hath been given unto authors in sciences, in making them dictators" to be followed and annotated, means that "the first author goeth furthest, and time leeseth and corrupteth." But in the "arts mechanical the first deviser comes shortest, and time addeth and perfecteth," as, for example, in artillery, sailing, and printing.[10] Finally, in the paragraph quoted above, we see that a history of these arts would be the perfect expression of Bacon's twofold desire for immediate and for future benefits—for experiments of fruit and experiments of light, production of works and discovery of laws.[11] The first of these purposes extends Vives's scheme of separate histories to a single organic project of one man's mind, since only then can the successful technique in one trade be applied to the improvement of another. The second purpose, new in Bacon,[12] and for him the more important, now seems a curious motive for a History of Trades. We, of course, associate the discovery of causes and axioms with hypothesis and laboratory experiment, but when Bacon failed to grasp the short-cut method of hypothesis and found no laboratories at hand for the collection of experimental data, he naturally turned to factories and workshops. For in his time they alone could supply conditions later reproduced in a laboratory, namely, when nature "by art and the hand of man . . . is forced out of her natural state, and squeezed and moulded." (*Ibid.*, IV, 29.) Indeed, as we shall see, even when Bacon plans a scientific college of research, some of his laboratories are workshops built on the grounds.

So important was the History of Trades in Bacon's mind that in 1608 he determined if possible to get it started himself. In July of that year we find a memorandum in his diary[13] which incidentally

[9] Part i, aphorism 74, in *Works*, IV, 74–75.

[10] *The Advancement of Learning*, in *Works*, III, 289–290.

[11] See *Works*, III, 165; IV, 17, 105.

[12] He says so himself in the *Parasceve*, in *Works*, IV, 254: "Natural History, which in its subject (as I said) is threefold, is in its use twofold. For it is used either for the sake of the knowledge of the particular things which it contains, or as the primary material of philosophy and the stuff and subject-matter of true induction. And it is this latter which is now in hand; now, I say for the first time."

[13] James Spedding, *The Letters and the Life of Francis Bacon, including all his Occasional Works* (1861–74), IV, 65–66, in the *Commentarius Solutus*.

gives a more detailed description of the scheme:

> To procure an History mechanique to be compiled w^th^ care and diligence (and to profess it that is of the experim^ts^ and observations of all Mechanicall Arts). The places or thinges to be inquyred are; first the materialls, and their quantites and proportions; Next the Instrum^ts^ and Engins requesite; then the use and adoperation of every Instrum^t^; then the woork it self and all the processe thereof w^th^ the tymes and seasons of doing every part thereof. Then the Errors w^ch^ may be comytted, and agayn those things w^ch^ conduce to make the woorke in more perfection. Then all observacions, Axiomes, directions. Lastly all things collaterall incid^t^ or intervenient.

But how was such a vast history to be written? The very next entry reads: "Layeng for a place to comand wytts and pennes. Westminster, Eton, Wynchester, Spec. Trinity College in Cambridg, S^t^ Jhons in Camb. Maudlin College in Oxford and bespeaking this betymes, w^th^ y^e^ K. my L. Archb. my L. Treasorer."[14] If he could get himself appointed to some commanding office in one of these schools or colleges, the scheme might be set on foot. "Qu. of young schollars in ye Universities," he continues; "*It must be the postnati.*" In the meanwhile, perhaps he could start by hiring some research workers to collect materials. And at once that purpose and that notion of cooperation stir his imagination to the conception of Solomon's House: "Foundac. of a college for Inventors" with a "Library and an Inginary . . . Vaults, fornaces, Tarraces for Insolacion; woork houses of all sorts." In a word, the collocation of entries shows Bacon's mind moving from the History of Trades to a scientific college where the plan could best be realized.[15] It is therefore hardly surprising that when he wrote the *New Atlantis* in 1624, he included, along with gardens and furnaces and observatories, "brew-houses, bake-houses, and kitchens," together with shops of "divers mechanical arts . . . papers, linen, silks, tissues; dainty works of feathers of wonderful lustre; excellent dyes, and many others."[16] These are the chief laboratories of the three "mystery-men," appointed to "collect the experiments of all mechanical arts." (*Ibid.*, 164.)

Before this, however, Bacon had published his principal account of the History of Trades—in the *Parasceve*, or *Preparative*

[14] That is, Bancroft and Salisbury, the chancellors, respectively, of Oxford and Cambridge.

[15] For this interpretation I am partly indebted to Spedding's introductory remarks on p. 25.

[16] *Works*, III, 159, 161.

towards a Natural and Experimental History, affixed to the *Novum Organum* (1620). Logically, this belonged to a later section of the *Magna Instauratio,* but as he explains, it is printed now because the indispensable natural history on which all scientific progress depends is a thing of great size, requiring vast labor and expense, and the help of many people. It must therefore be started at once, and on the method herein laid down.[17] The aphorisms that follow expand the passage on natural history in *The Advancement of Learning,* insisting again that of the three kinds, "the history of Arts is of most use, because it exhibits things in motion, and leads more directly to practice"; and again protesting against "all fineness and daintiness" which considers such work too mechanical and illiberal for gentlemen to stoop to. (*Ibid.,* 257.) After the aphorisms, Bacon prints a "Catalogue of Particular Histories by Titles," those of trades running from numbers 81 to 128, and including all those which later were written or planned during the century. And as we shall see, the later work was probably guided by Bacon's own selection of the most important (*ibid.,* 257–258):

> Among the particular arts those are to be preferred which exhibit, alter, and prepare natural bodies and materials of things; such as agriculture, cookery, chemistry, dyeing; the manufacture of glass, enamel, sugar, gunpowder, artificial fires, paper, and the like. Those which consist principally in the subtle motion of the hands or instruments are of less use; such as weaving, carpentry, architecture, manufacture of mills, clocks, and the like; although these too are by no means to be neglected.

At this point we can summarize our conclusions as follows. Bacon reached his original conception of a History of Trades from two related premises: in general, from the first principle of his thought, the inductive study of nature for the use and benefit of man; and in particular, from the groundwork for such a study in a new natural history that would include and emphasize the mechanical arts. Once achieved, such a history would benefit mankind by the discovery not only of many ingenious practices in trades, but also, and primarily, of scientific causes and axioms. The project was thus bound up tightly with the Baconian program for the advancement of learning. That is why we hear no more of a History of Trades until, in the 1640's, Bacon's thought began to bear fruit.

[17] *Works,* IV, 251, 252.

II

Broadly speaking, we can see Bacon's influence, after 1640, working in two directions, each corresponding roughly with a particular group of men. On the one hand, it stimulated the growth of experimental philosophy and the formation of a cooperative group of scientists. This group was first organized as the "Invisible College" in 1645, was continued at Oxford in the 1650's, and was given formal embodiment in 1663 as the Royal Society. Because their various interests were centered in the common goal of a Baconian natural history, these men were inevitably concerned with the manual arts; and, as we shall see, one of their leaders, Robert Boyle, was already thinking in 1647 of the great History of Trades which was later undertaken by the Royal Society.

At the same time the broader implications of Bacon's thought were affecting another set of men who were primarily reformers rather than scientists in the strict sense. This group, typified and largely led by Samuel Hartlib, and including John Dury, William Petty, and John Evelyn, was thinking less about "experiments" than "improvements," less about scientific laws than the amelioration of society.[18] To some extent they found in Bacon practical suggestions for what they called "the reformation of the whole world,"[19] but their main debt is less concrete and more potent—the inspiration to apply knowledge to the immediate and practical needs of middle-class society. We have, for example, the testimony of Hartlib's friend, John Dury, in 1649, that "the advancement of learning hath been oftener and in a more public way at least mentioned in this nation of late than in former times, partly by the publication of those excellent works of the Lord Verulam."[20] And more significant, we find that the master of Hartlib's Office of Address is "to put in Practice the Lord *Verulams* Designations,

[18] It is true that Petty and Evelyn were both members of the Royal Society, and that Petty in particular worked with Boyle at Oxford on experimental anatomy. But since both thought of the History of Trades as primarily a contribution to social and commercial improvement, I place them here. The two categories are not to be taken too rigidly.

[19] *The Works of the Honourable Robert Boyle,* ed. T. Birch (1772), VI, 132, in a letter from Hartlib to Boyle, Nov. 15, 1659. *Cf.* Petty's remark below, p. 42.

[20] *A Seasonable Discourse Written by Mr. J. Dury* (1649), quoted in Foster Watson, *The Beginnings of the Teaching of Modern Subjects in England* (1909), p. 230.

De Augmentis Scientiarum, amongst the Learned."[21]

As we shall see in a moment, the designation uppermost in Hartlib's mind was the History of Trades, but not as part of a natural and experimental history. It is Bacon's secondary motive that appeals to Hartlib and his group. This general shift in emphasis from philosophy to practice, with special reference to the practice of trades, can be seen at once when we compare *Macaria* (1641) with the *New Atlantis* on which it was modelled. In Hartlib's utopia we find that Solomon's House is dedicated not to "the knowledge of Causes, and secret motions of things," but to the immediate and commercial improvement of middle-class society:

> They have an house, or College of Experience, where they deliver out, yearly, such medicines as they find out by experience; and all such as shall be able to demonstrate any experiment, for the health or wealth of other men, are honourably rewarded at the publick charge.[22]

Moreover, the college is a minor element. Most of the tract is devoted to the councils of husbandry, fishing, trade by land, trade by sea, and new plantations, organized to the end that men may "live in great plenty, prosperity, health, peace, and happiness." (*Ibid.,* 381.)

The same frame of mind, sympathetic to a History of Trades, can be seen also in John Dury. In *The Purpose and Platform of my Journey into Germany* (1631),[23] the main purpose is to find a basis of union among all Protestants. But in the course of his travels, Dury also planned, he says, to observe "all Inventions, and Feats of Practise in all Sciences":

> For Inventions and Industries, I will seeke for such chiefly as may advance learning and good manners in the Universities, Schooles, and Commonweales; next for such as may bee profitable to the health of the body, to the Preservation and Encrease of wealth by trades and mechanicall Industries, either by sea or Land; either in Peace or Warre.

That quotation shows how commercial motives combined with the influence of Bacon and Comenius to foster a reform of education

[21] *Considerations Tending to the Happy Accomplishment of Englands Reformation* (1647), p. 47; and cf. pp. 50–51.

[22] *A Description of the Famous Kingdome of Macaria* (1641), reprinted in *The Harleian Miscellany* (8vo. ed., 1808–11), IV, 382.

[23] Printed by G. H. Turnbull, *Samuel Hartlib* (1920), pp. 10–13, from Sloane MSS. (British Museum) 654, ff. 247–249. The quotation below is on p. 11.

based on the study of "things" and the introduction of scientific and vocational training. This is the educational theory we find in the two works directly inspired by Hartlib—Dury's *The Reformed School* (about 1649) and Petty's *The Advice of W. P. to Mr. S. Hartlib for the Advancement of Some Particular Parts of Learning* (1648). Indeed, in Petty's program we find that the principal text-book is the History of Trades.

In this respect, the immediate background of Petty's *Advice* is important. Late in 1647, the year in which Hartlib spoke of his Office of Address putting "in Practice the Lord Verulams Designations," he sent to Boyle a "design of the History of Trades," assuring him that it was the "meat or banquet to which I desire to invite mainly all ingenious spirits and discerning palates at this time"; and he appeals to Boyle for financial support, certain that "to your sense it will be a delicacy, and the best venison that ever I could have hunted out for you in this populous wilderness."[24] As the final remark implies, Hartlib knew that he was turning to a sympathetic mind, and through Boyle to his associates in the Invisible College, who would welcome so necessary a contribution to Bacon's natural history. In this way, I suggest, Hartlib was counting on the alliance of the two groups. And by a lucky chance, he had found a man for the job who combined both points of view.

For the actual design, the outline of the scheme sent to Boyle, was not Hartlib's. "The author . . . is one *Petty,* of twenty-four years of age . . . a most rare and exact anatomist, and excelling in all mathematical and mechanical learning"; and it is Petty who is to write the history if and when "at least a hundred and twenty pounds *per ann.*" can be guaranteed. To help raise these funds Hartlib has asked him to write out a specimen "in one trade (which also is near done) and set down all the terms and conditions upon which he desires that annual assistance."[25]

Petty was ideally suited for the work. The son of a clothier who "also did dye his owne clothes," his greatest delight as a boy "was to be looking on the artificers,—e.g. smyths, the watchmakers, carpenters, joyners, &c.—And at twelve yeares old could have

[24] *The Works of Boyle* (1772), VI, 76, 77.

[25] *Ibid.* The actual design is quite possibly the papers for Petty's History of Trades, Sloane MSS. (British Museum), 2903, 63 ff, which I have been unable to see.

worked at any of these trades.''[26] At fifteen he went to France, ''and began to play the merchant, and had so good successe that he maintained himselfe, and also educated himselfe.'' (*Ibid.*, 482.) Besides Latin, Greek, and French, he learned, as he says himself, ''the whole body of common Arithmetick, the practicall Geometry and Astronomy conducing to Navigation, Dialing, &c. with the knowledge of severall Mathematicall Trades.''[27] Back in England in 1646, he took up his father's trade of clothier, and ''devoted himself to the study of mechanical improvements in textile processes.''[28] This was the person of ''admirable inventive head, and practicall parts''[29] whom Hartlib, with his keen eye for genius, discovered in 1647, and at once determined to make the historian of trades.

But at that time it was not easy to raise £120 a year. Meanwhile, Petty might begin work on another of Hartlib's favorite schemes, the reform of education. Already Hartlib had publicized the theories of Comenius and persuaded Milton to write his tractate; and here was a man who had actually had the very type of education desiderated by the reformers—the broad encyclopedic range, the scientific subjects, the stress on ''real'' as opposed to verbal learning. Petty, however, was not an educationalist. He was a business man, fascinated by the possibilities of applied science. As Hartlib talked with his protégé, they must suddenly have hit on a brilliant idea. Within the framework of a Comenian essay, why not propose a scientific college on the model of Solomon's House, with a faculty of tradesmen engaged mainly on industrial experiments—and on the writing of a History of Trades for the common benefit of scientists and artificers? In fact, wouldn't such a history have so many values even for laymen that it would in itself be the principal text-book of the new education? Once we gain this perspective, we see how misleading is the common notion that Petty's *Advice* is simply another contribution to Comenian

[26] John Aubrey, *Letters Written by Eminent Persons in the Seventeenth and Eighteenth Centuries* (1813), II, 481.

[27] From his will, reprinted in Lord Edmund Fitzmaurice, *The Life of Sir William Petty, 1623–1687* (1895), pp. 318–319.

[28] Lord Edmund Fitzmaurice, in the *D.N.B.* article on Petty. This makes it highly probably that the specimen of one trade which Hartlib says Petty had nearly completed in 1647 was a history of clothing. Years later he read a history of clothing to the Royal Society. See below, p. 52.

[29] Aubrey, *op. cit.*, II, 486.

education. Its main inspiration is not Comenius but Bacon—Bacon of the *New Atlantis* and of the history of mechanical arts, as his thought was modified by the more utilitarian and commercial spirit of Hartlib and Petty. But its immediate provocation, the spark that set pen to paper, was the letter to Boyle; and its primary purpose, I believe, is to persuade a wide audience to support the scheme for a History of Trades.

After two pages on the education of children in literary workhouses which should combine practical studies with the learning of a trade, we come to the heart of the essay, the erection of "a *gymnasium mechanicum* or a college of tradesmen," "for the advancement of all mechanical arts and manufactures":[30]

> From this institution we may clearly hope . . . that all trades will miraculously prosper, and new inventions would be more frequent, than new fashions of cloaths and household-stuff. Here would be the best and most effectual opportunities and means, for writing a history of trades, in perfection and exactness; and what experiments and stuff would all those shops and operations afford to active and philosophical heads, out of which, to extract that interpretation of nature, whereof there is so little, and that so bad, as yet extant in the world?

The appeal at once to London tradesmen and Gresham College philosophers is skilfully handled; and the appeal is quite definite, for Petty is not talking utopias. "For more expedition, until such a place could be built, . . . the most convenient houses, for such a purpose, may be either bought or hired." (*Ibid.*, 146.) Beyond that there will be no further expense, since in lieu of salary, the tradesmen-fellows will have a ready market for goods produced by such famous workmen.

After the outline of institutions, that is, the literary workhouses and the new college, "we now come to speak of such books, as, being well studied and expounded in those schools, would lay a very firm foundation of learning in the scholars."

> We recommend therefore in the first place . . . the compiling of a work, whose title might justly be *Vellus Aureum sive Facultatum Lucriferarum Descriptio magna,* wherein all the practised ways of getting a subsistence, and whereby men raise their fortunes, may be at large declared. And, among these, we wish that the history of arts or manufactures might

[30] *The Advice of W. P. to Mr. Samuel Hartlib for the Advancement of Some Particular Parts of Learning* (1648), reprinted in *The Harleian Miscellany* (8vo. ed., 1808–11), VI, 146.

first be undertaken as the most pleasant and profitable of all the rest, wherein should be described the whole process of manual operations and applications of one natural thing, (which we call the elements of artificials) to another, with the necessary instruments and machines, whereby every piece of work is elaborated, and made to be what it is; unto which work bare words being not sufficient, all instruments and tools must be pictured, and colours added, when the descriptions cannot be made intelligible without them. (*Ibid.*, 152–153.)

We need not linger on Petty's exposition of "the nature, manner, and means of writing the history of trades," beyond noticing the personal reference when he says that the compiler must be a young man if he is to finish the work (Petty was twenty-five at the time). But the long list that follows of "profits and commodities" redounding to society from such a book—inserted, significantly enough, "for the better encouragement of the undertakers" (*ibid.*, 155)—is of the first importance. A few selections (*ibid.*, 155–157) will indicate the range of utility which justifies the claim he later made that the History of Trades was one of "the great pillars of the reformation of the world."[31]

All men whatsoever may hereby so look into all professions, as not to be too grossly cozened and abused in them.

Scholars, and such as love to ratiocinate, will have more and better matter to exercise their wits upon, whereas they now puzzle and tire themselves, about mere words and chimerical notions.

All men in general that have wherewithal will be venturing at our *vellus aureum*, by making of experiments: and whether thereby they thrive or no, the directions in the preface being followed, they shall nevertheless more and more discover nature.

All ingenious men, and lovers of real knowledge, have a long time begged this work, wherefore it can be no small honour to him that shall satisfy them.

A vast increase of honourable, profitable, and pleasant inventions must needs spring from the work, when one man (as the compiler thereof) may, *uno intuitu*, see and comprehend all the labour and wit of our ancestors, and be thereby able to supply the defects of one trade with the perfections of another.

There would not then be so many fustian and unworthy preachers in divinity, so many petty-foggers in the law, so many quack-salvers in physick, so many grammaticasters in country schools, and so many lazy

[31] *The Works of Boyle*, VI, 113, quoted in a letter from Hartlib to Boyle, Aug. 10, 1658.

serving-men in gentlemen's houses, when every man might learn to live otherwise in more plenty and honour; for all men, desirous to take pains, might, by this book, survey all the ways of subsistence, and chuse out of them all one that best suits with his own genius and abilities.

Boys, instead of reading hard Hebrew words in the bible (where they either trample on, or play with mysteries) or parrot-like repeating heteroclitous nouns and verbs, might read and hear the history of faculties expounded . . . It would be more profitable to boys to spend ten or twelve years in the study of things, and of this book of faculties, than in a rabble of words.[32]

This work will be an help to eloquence, when men, by their great acquaintance with things, might find out similitudes, metaphors, allusions, and other graces of discourse in abundance.

To arithmeticians and geometricians, supplying them with matter, whereon to exercise those most excellent sciences. . . . The number of mixt mathematical arts would hereby be increased.

Divines, having so large a book of God's works, added to that of his word, may, the more clearly from them both, deduce the wisdom, power, and goodness of the Almighty.

Lastly, This history, with the comments thereupon, and the indexes, preface, and supplements thereunto belonging, would make us able, if it be at all possible, to demonstrate axioms in philosophy, the value and dignity whereof cannot be valued or computed.

Anyone familiar with the period will see in this list an extraordinary reflection of the 'climate of opinion'—the new philosophy, the rejection of Scholasticism, the commercial drive, the attack on grammar with the demand for a practical study of things, the sop to rhetoric in the promise of new materials for tropes,[33] the growth of applied mathematics, the apology for science as the study of God's second book, and over all, the full spirit of utilitarianism. Is it too much to say that in Bacon's conception of the History of Trades, Petty has condensed and focussed the ideals of the scientific middle-class society which was born in the Interregnum and grew up in the Restoration? And it is literally Bacon's conception, for after the last "profit," Petty concludes the essay:

[32] In *The Petty Papers*, edited by the Marquis of Lansdowne (1927), II, 45, is a document called "Three Sorts of Education, 1686." In the first curriculum, which the editor suggests is for "a successful man of the world," we find the History of Trades as a subject of study.

[33] *Cf.* Sprat in 1667, *The History of the Royal Society* (ed. 1734), pp. 413–417. Since "the *Wit* of the *Fables* and *Religions* of the *antient World* is well-nigh consumed," the new science will supply fresh imagery drawn from "a vast Number of *Natural* and *Mechanical* Things."

The next book, which we recommend, is the history of nature free; for indeed the history of trades is also an history of nature, but of nature vexed and disturbed. What we mean by this history, may be known by the Lord Verulam's most excellent specimen thereof; and, as for the particulars that it should treat on, we refer to his exact and judicious catalogue of them, at the end of his advancement of learning.[34]

III

It was at his own house in 1656, and probably on April 12th in the company of Wilkins and Jeremy Taylor, that Evelyn first met Boyle.[35] They were at once attracted to each other, and Evelyn has described how the acquaintance ripened quickly into friendship.[36] After a polite exchange of "divers letters . . . in civilities, . . . we became perfectly acquainted and had discovered our inclination of cultivating the same studies and designes, especially in y^e^ search of natural and usefull things"; and of one thing in particular, for Evelyn continues:

my selfe then intent on collections of notes in order to an History of Trades and other mechanical furniture, which he earnestly incouraged me to proceed with: so that our intercourse of letter was now only upon y^t^ account, and were rather so many receipts and processes, than letters.

We are, of course, prepared for Boyle's enthusiastic support of the scheme which had been abandoned in 1648; but what had led Evelyn just at that time and independently of Boyle, to undertake the same work? On November 27, 1655, he paid a visit to "honest and learned Mr. Hartlib, a public spirited and ingenious person, who had propagated many usefull things and arts."[37] In Evelyn's notes on the conversation, there is mention only of various mechanical inventions, and the conclusion, "This gentleman was a master of innumerable curiosities and very cummunicative." Five months later Evelyn is "intent on collections of notes in order to an History of Trades." One can scarcely imagine that the loqua-

[34] *Ibid.*, Page 157. He means, of course, at the end of the *Novum Organum.*

[35] In 1696, Evelyn speaks [in the *Diary of John Evelyn, Esq., F.R.S., to which are added a Selection from his Familiar Letters,* edited by Henry B. Wheatley (1879), III, 481] of meeting Boyle "almost fourty yeares since;" and (IV, 34) at his own house at Deptford. The entry for April 12, 1656 (II, 83) is the first mention of Boyle.

[36] In a letter to William Wotton, Sept. 12, 1703 (*ibid.*, IV, 35–36).

[37] *Ibid.*, II, 80.

cious Hartlib, finding Evelyn concerned at once with mechanical arts and public improvements, and possessed of a good-sized income, could have failed to mention the project of 1648 and its manifest advantages to society. It is true, no doubt, that a work which "all ingenious men and lovers of real knowledge, have a long time begged" was already in Evelyn's mind, and would, in any case, have appealed to a man so devoted to public service and the new philosophy; but the collocation of dates makes it highly probable that some remark of Hartlib's set Evelyn going. At any rate, Hartlib had a share in the new venture, for it is to him that Evelyn sent, in 1659, a specimen of a history of the trade of gardening, which Hartlib in turn was to send on to Boyle for further criticism.[38]

About a year after their first meeting, Evelyn reports to Boyle on his progress, in a letter so important that most of it must be quoted.[39] Of the "trifles" which Boyle was pleased to command, he encloses only a receipt for making varnish;[40] as for the other trades,

> I have omitted those of brasse, &c. because they properly belong to Etching and Ingraving: which treatise, together with five other (viz. Paynting in Oyle, in Miniature, Anealing in Glasse, Enamiling, and Marble Paper), I was once minded to publish (as a specimen of what might be further done in the rest) for the benefit of the ingenious: but I have since ben put off from that designe, not knowing whether I should do well to gratifie so barbarous an age (as I feare is approaching) with curiosities of that nature, delivered with so much integrity as I intended them: and least by it I should also disoblige some, who made those professions their living: or, at least, debase much of their esteeme by prostituting them to the vulgar. Rather, I conceived that a true and ingenious discovery of these and the like arts, would, to better purpose, be compiled for the use of that Mathematico-Chymico-Mechanical Schoole designed by our noble friend D^r^ Wilkinson, where they might (not without an oath of secresy) be taught to those that either affected or desired any of them: and from thence, as from another Solomons house, so much of them onely made publique, as should from tyme to tyme be judged convenient by the superintendent of that Schoole, for the reputation of learning and benefit of the nation. And upon this score, there would be a most willing contribution of what ingenious persons know of this kind, & to which I should most freely dedicate what I have."

[38] *Ibid.*, III, 261, in a letter, dated Aug. 9, 1659.

[39] *Ibid.*, III, 235, dated May 9, 1657.

[40] This was probably used by Boyle for his own history of varnish. See below, p. 52.

In the first place, this letter marks the difference between Evelyn and his associates. The superior tone of the gentleman scholar, condemned by Vives and Bacon, never appears in Hartlib or Petty, and was scorned by Boyle.[41] In the next place, this attitude, as it combines with the aesthetic side of his nature, determines the kinds of trades which we see Evelyn willing to examine, those which are not so much manual arts as fine arts. Finally, the letter prophesies what later became a fact, that the scheme might best be undertaken in such a scientific foundation as Dr. Wilkins was planning, that is to say, in the Royal Society, and that to such an academy, Evelyn would, as we shall see that he did, freely dedicate his own histories.[42]

After this letter we half expect the confession two years later that "in the History of Trades, I am not advanced a step"; nor are we surprised at his excuse, that he cannot support "the many subjections . . . of conversing with mechanical capricious persons." And so the design is abandoned, with the acknowledgment of his fault "if from any expression of mine there was any room to hope for such a production, farther than by a short collection of some heads & materials, & a continual propensity of endeavouring in some particular, to encourage so noble a work, as far as I am able."[43]

But even as he was writing, circumstances were forming to give ample room for such a hope, and in less than two years his own collection of heads and materials was the basis of a fresh attempt. For in 1658 many of the Oxford virtuosi came up to London, and there we find the weekly meetings at Gresham College which were to lead directly to the Royal Society; and there, with other "eminent Persons of their common Acquaintance," they were joined by "Mr. *John Evelyn.*"[44]

[41] See below, p. 50.

[42] "Dr. Wilkinson" is an error for "Dr. Wilkins." Obviously referring to this letter, William Wotton, at work on his life of Boyle, wrote to Evelyn in 1703 (*Diary*, IV, 32): "In one of your l^res^ to Mr. B. you mention a Chymico-Mathematico-Mechanical Schole designed by Dr. Wilkins: what farther do you know about it?" To which Evelyn answered (p. 34), that at Oxford in the 1650's there was "a famous assemblage of virtuosi," where Boyle, Christopher Wren, Seth Ward, "and especially Dr. Wilkins (since Bishop of Chester): the head of Wadham Coll: . . . used to meete to promote the study of the new philosophy, which has since obtained. It was in that Colledge where I think there was an elaboratory, and other instruments mathematical, mechanical, &c. which perhaps might be that you speake of as a schole"—that is to say, which I spoke of in that letter.

[43] *Diary*, III, 260–261, in a letter to Boyle, Aug. 9, 1659.

[44] Sprat, *History of the Royal Society*, p. 57.

IV

Both in aims and methods, as in size and range of membership, the Royal Society was nicely constituted to attack the History of Trades. Their purpose, wrote Sprat (*ibid.*, 61), is "to make faithful *Records* of all the Works of *Nature*, or *Art*"; their method is "to heap up a mixt Mass of *Experiments*," registered "as bare unfinish'd Histories." (*Ibid.*, 115.) In this Baconian way, the society would avoid the barren fruits of the old philosophers, busy with speculative opinions instead of the solid groundwork of natural history (*ibid.*, 118). It is significant that Sprat finds the sterility of ancient thought obstructing trade quite as much as natural philosophy. What help, he asks, did it ever bring to the vulgar? "What visible Benefit to any City or Country in the World? Their *Mechanicks*, and *Artificers* (for whom the true natural Philosophy should be principally intended), were so far from being assisted by those abstruse Doctrines," that learning made no contribution to "Professions and Trades." (*Ibid.*, 117–118.) All this, of course, is straight Bacon—all except the highly significant clause in the parentheses. For Bacon had said, "I care little about the mechanical arts themselves: only about those things which they contribute to the equipment of philosophy."[45] The notion that natural philosophy was principally intended for mechanics and artificers would have shocked him profoundly. That Sprat could adopt such a position so casually, and in the face of his claim that the Royal Society was the child of Bacon's thought,[46] is largely explained, I think, by a passage like the following:

> Of our chief and most wealthy *Merchants* and *Citizens*, very many have assisted it with their Presence; and thereby have added the industrious, punctual, and active *Genius* of Men of *Traffick*, to the quiet, sedentary, and reserv'd Temper of Men of *Learning*. They have contributed their *Labours;* they have help'd their *Correspondence;* they have employ'd their *Factors* abroad to answer their *Inquiries;* they have laid out in all Countries for *Observations;* they have bestow'd many considerable Gifts on their *Treasury* and Repository.

And he goes on to praise the recent establishment by Sir John Cutter of a lectureship in mechanics, to be read "where the *Royal Society* shall meet," the first lecture of its kind, and "the most necessary of all others."

[45] *Works*, IV, 271, at the end of the *Parasceve*.

[46] *History*, pp. 35, 144.

For this has chiefly caus'd the slow Progress of *manual Arts;* that the *Trades* themselves have never serv'd *Apprentiships,* as well as the *Tradesmen;* that they have never had any *Masters* set over them, to direct and guide their Works, or to vary and enlarge their Operations.[47]

Late in the volume a long and glowing section is devoted to "the Purpose of the *Royal Society,* and the probable Effects of *Experiments,* in respect of all the *Manual Trades.*" (*Ibid.,* 378–403.)

The fact is, of course, that the Royal Society was riddled with a utilitarian and commercial spirit far beyond anything in Bacon. He was writing for the Stuart court and the learned scholars of Europe, appealing for the advancement of natural philosophy. Sprat is writing quite as much for the city and the country, giving the advancement of trade and industry an equal place with the advancement of pure science. The difference is seen with significant clarity in the famous passage on style, where the society goes on record as preferring "the Language of Artizans, Countrymen, and Merchants, before that of Wits, or Scholars." (*Ibid.,* 113.) Or, with greater relevance to our purpose, the shift in emphasis comes out in Hooke's remark that "they [the members of the Royal Society] do not wholly reject Experiments of meer *light* and *theory*; but they principally aim at such, whose Applications will *improve* and *facilitate* the present way of *Manual Arts.*"[48] In short, it was primarily the acquisitive temper of the middle-class, building on the heritage of Bacon and the social reformers, that directed the virtuosi to the History of Trades.

The project was at once brought to their notice by two members already prepared with plans and methods. In the minutes for the meeting of January 16, 1661, we find the following entries:[49]

The catalogue of trades brought in by Mr. Evelyn, and that of Dr. Petty, were referred to them and Dr. Merret, to be compared, methodised, and returned to the society. . . .

Dr. Merret was requested to bring in writing that account of refining, which he had delivered in discourse this day. . . .

Mr. Evelyn was desired to bring in an history of engraving and etching: And

Dr. Petty to communicate the history of some trade at his own choice.

[47] *Ibid.,* 129–130. *Cf.* other salutes to the "*noble* and *inquisitive Genius of* our *Merchants*" on pp. 67, 88, 121, 407.

[48] Robert Hooke, *Micrographia* (1665), preface, quoted in Jones, *Ancients and Moderns,* p. 206.

[49] Thomas Birch, *The History of the Royal Society of London for Improving of Natural Knowledge* (1755–1757), I, 12.

Petty's catalogue, which must have been drawn up originally for Hartlib in 1647, is very likely the list of histories, modelled on Bacon, which still exists among his *mss.*[50] And I assume that Evelyn's paper, which he calls "my Circle of Mechanical Trades,"[51] is the "short collection of some heads & materials" that he mentioned to Boyle in 1659. The actual document is preserved in the Archives of the Royal Society. It consists of four pages, in Evelyn's own hand, with the title, *History of Arts Illiberal and Mechanical.* The arts are divided into eight groups, the last of which is headed "Exotick and very rare Seacrets."[52] Five months later, when Evelyn drew up a design for the library of the Royal Society, he included, of course, a section of "Books of Arts Illiberal and purely Mechanick," the working bibliography for the history, divided into sections which must correspond roughly with the grouping mentioned above: "Usefull & Vulgar, Meane, Servile, Rusticall, Female, Polite, More Liberall, Curious, Exotick, Modells & Engines belonging to them."[53]

Quickened by this initial meeting, interest in the History of Trades steadily increased. A few weeks later Petty talked to the King for "half an hour before the forty Lords, upon the philosophy of shipping, loadstones, guns, &c., feathering of arrows, vegetation of plants, the history of trades, &c., about all of which I discussed *intrépide* and I hope not contemptibly."[54] Later in the year, Cowley's *Proposition for the Advancement of Learning* outlined a philosophical college in which men were to learn "the Mysteries of all Trades, and Improvement of them; the Facture of all Merchandizes, . . . and briefly all things contained in the Catalogue of Natural Histories annexed to My Lord *Bacon's Organon.*"[55] Within the Royal Society itself the subject was constantly

[50] Printed in *The Petty Papers,* I, 203–205.

[51] *Diary,* II, 122, under Jan. 16, 1661.

[52] Since I have been unable to see the *ms.,* I have taken these facts from A. H. Church, *Evelyn's Sculptura, with the Unpublished Second Part,* ed. C. F. Bell (1906), part II, pp. i–ii; and Geoffrey Keynes, *John Evelyn; a Study in Bibliography & a Bibliography of his Writings* (1937), p. 112.

[53] Keynes, p. 18. The *ms.* is dated May 22, 1661.

[54] Quoted by Fitzmaurice, *The Life of Petty,* p. 104, from a letter to his brother John, Feb. 5, 1661.

[55] In *Abraham Cowley; the Essays and Other Prose Writings,* ed. A. B. Gough (1915), p. 34.

under discussion. In March, "Dr. Merret was to be asked for the catalogue of trades, which he took, of Mr. Evelyn's and Dr. Petty's." (Birch, *loc. cit.*, I, 19). On May 22nd, "the business of the history of trades was appointed to be discoursed of at the next meeting" (I, 24), though no discussion appears in the minutes for May 28th. A similar promise occurs in an entry for October 23rd: "Dr. Merret and Dr. Clarke were desired to bring in their account of trades at the next meeting." (I, 50.) Finally, the matter was apparently turned back to Petty, who promised on February 26, 1662, "to produce on that day fortnight his paper concerning trades." (I, 77.)

In the meanwhile various particular histories had been planned or written. Drawing on his first-hand experience, Petty had read papers on the history of clothing, the history of dyeing, and "propositions concerning shipping."[56] Boyle had been asked "for what he knew relating to varnish," and Oldenburg was to write on "making steel and lattin plates."[57] I find no notice of Christopher Merret's account of refining, but in 1662 he translated the Italian work of Antonio Neri, *De Arte Vitraria* (1612), a book which Boyle was later to cite as a model of mechanical history.[58] Finally, Evelyn had contributed an "*Account of the making of marbled paper,*"[59] and then elaborated another of the treatises written in association with Boyle, that on etching and engraving,[60] which he published in 1662: *Sculptura; or, The History and Art of Chalcography and Engraving in Copper.*

[59] Birch, I, 69, dated Jan. 8, 1662.

The dedication to Boyle, at whose "reiterated instances," Evelyn says, the work was prepared, is only natural. But this is followed, unexpectedly, by "An Account of Signor Giacomo Favi,"

[56] The paper on clothing, read on Nov. 27, 1661, is reprinted by Birch, I, 55–65; that on dyeing, read on May 7, 1662 (Birch, I, 83), was published in 1667 by Sprat in *The History of the Royal Society* (ed. 1734), pp. 284–301. The material on shipping (Birch, I, 65) was presented on Nov. 27, 1661.

[57] Birch, I, 52, dated Oct. 30, 1661. It will be recalled (see above p. 47) that Evelyn sent a history of varnish to Boyle in 1657. See also below, p. 59.

[58] *The Art of Glass wherein are shown the wayes to make and colour glass, pastes, enamels, lakes, and other curiosities, . . . translated into English, with some observations on the author,* London, 1662. For Boyle's mention of this work, see below, p. 59.

[60] See the letter quoted above, p. 50.

which has nothing to do with engraving, and which seems, from Evelyn's description, to be utterly irrelevant. It is taken, he says, from a discourse of M. Sorbière's "concerning the utility of great travel and forreign voyages";[61] and translated here "because it approaches so neer to the idea which I have propos'd, and may serve as an encouragement and example to the gentlemen of our nation, who for the most part wander, and spend their time abroad, in the pursuit of those vain and lower pleasures, fruitless, and altogether intollerable."[62] The example which Favi gives is not, however, related to the usual precepts for the *grand tour*. On the contrary, Favi went from country to country "collecting with a most insuperable diligence all that the mechanics had invented for Agriculture, Architecture, and the fabric of all sorts of works, belonging to sports, and to cloathes, for use and for magnificence." (*Ibid.*, 248.) Then, at the close of the sketch (p. 250), Evelyn himself draws the moral:

> His intention was, as I have been credibly inform'd by one that did often converse with him (though Monsieur Sorbière is silent of it) after he had travelled over all the world (for his designe was no lesse ample) at returne into his native country, to compile, and publish a compleat Cycle and History of Trades, with whatsoever else he should judge of use and benefit to mankind: but this had been a charity and a blessing too great for the world, because it do's not depart from its vices and impertinences, and cherish such persons, and the virtues which should render it worthy of them.

This explains why Favi's life approached the idea which Evelyn had proposed, and why it is prefixed to the *Sculptura*. For the published volume is plainly intended to call the "gentlemen of our nation" to similar contributions toward a complete cycle of trades. And not merely gentlemen. At the end of the book, Evelyn inserted an important note. He had intended, he says, to add a translation of M. du Bosse's treatise on the rolling press, but had desisted when he heard that William Faithorn, the engraver, was planning to translate the same work. Given this occasion, Evelyn concludes:

[61] Samuel de Sorbière (1615–1670), *Lettres et Discours sur Diverses Matières Curieuses* (Paris, 1660), lettre lxxxiii, p. 644.

[62] The dedication, in *The Miscellaneous Writings of John Evelyn*, ed. William Upcott (1825), p. 246.

I could wish, with all my heart, that more of our workmen would (in imitation of his laudable example) impart to us what they know of their several trades and manufactures. . . . For what could so much conduce to their profit and emolument? when their several mysteries being subjected to the most accurate inspection and examen of the more polite and enquiring spirits, they should return to their Authors again so greatly refin'd and improved,[63] and when (through this means also) Philosophy her self might hope to attain so considerable a progress towards her ultimate perfection.[64]

One feels here, and still more in the previous passage, that Evelyn is somewhat discouraged. Neither gentlemen nor workmen had apparently backed the History of Trades with the vigor he desired. The activity cited above was largely confined, we notice, to the old guard—that is, to Petty, Boyle, and Evelyn himself. The project had not yet caught on, as it did later after 1664. This accounts for Evelyn's discouragement in 1662, and provides a further explanation of his earnest appeal to gentlemen and workmen.[64a]

He himself continued his efforts, developing the early specimen sent to Hartlib on the trade of gardening[65] into his largest work, published in 1664:

Sylva, or a Discourse of Forest-Trees, and the Propagation of Timber in his Majesties Dominions. By J. E. Esq. As it was deliver'd in the Royal Society the XVth of October, MDCLXII; . . . to which is annexed Pomona, or an Appendix concerning Fruit Trees in relation to Cider, the making and severall wayes of ordering it. Published by express order of the Royal Society. Also Kalendarium Hortense, or the Gard'ners Almanac, directing what he is to do monethly throughout the year.

[63] *Cf.* Sprat's remark quoted above, p. 49.

[64] *Miscellaneous Writings*, pp. 335–336. We notice that Evelyn, in contrast to Bacon, and in harmony with the Royal Society, sees the scientific value of mechanical history as subordinate to its commercial value. His translation of du Bosse was published as part II in C. F. Bell's edition of *Sculptura* (1906).

[64a] In this connection we have the evidence of the anonymous translator of Guido Pancirollus, *The History of Many Memorable Things Lost* (1715), appendix, p. 431, where he finds that the attempts of the virtuosi "to look into our Manufactures, Country-Business, and common Shop-Trades" to make them "more easy and gainful" were "met at first with no small Discouragements, even from the Mechanicks themselves."

[65] See above, p. 47.

If this hardly seems part of the History of Trades, we need only refer back to Bacon's catalogue, "History of Agriculture, Pasturage, Culture of Woods, &c.; History of Gardening."[66] And in any case Evelyn himself wrote to Wotton in 1703 that "what I gathered of this nature [the collections made with Boyle toward "an History of Trades"], and especially for the improvement of planting and gardening; my Sylva and what else I published on that subject, being but part of that work, . . . would astonish you, did you see the bundles and packets."[67] Among these bundles and packets were certainly the four treatises mentioned earlier on "Paynting in Oyle, in Miniature, Anealing in Glasse, Enamiling," as well as his *Panificium, or the Several Manners of Making Bread in France,* read to the society on March 1, 1665.[68] Nor does this exhaust Evelyn's contribution, for we must add also, I think, another of his principal works, *A Parallel of the Ancient Architecture with the Modern,* translated from the French of Roland Fréart (1664). This is primarily a critical essay on architecture as a fine art, but the title-page insists that it was "made English for the benefit of builders"—a purpose emphasized by Evelyn's glossary of technical terms which he says is intended even for "the capacities of the most vulgar understandings."[69] Moreover, he connects the *Parallel* directly with *Sylva:* "After I had (by the commands of the Royal Society) endeavour'd the Improvement of Timber and the Planting of Trees, I have advanced to that of Building, as its proper and natural consequent." (*Ibid.,* 339.)

As long ago as 1755, an anonymous biographer claimed that Evelyn's "great work was to have been intitled, 'A general History of all Trades'."[70] No proof was given, and none exists today to warrant the remark as a statement of fact. And yet, when we look back over all the evidence assembled and remember in particular the eulogy of Favi, we see that as a piece of criticism the remark is penetrating. For it indicates the neglected truth that

[66] *Works,* IV, 270.

[67] *Diary,* IV, 34. This follows the quotation given above, p. 47.

[68] Birch, II, 19. It was published in John Houghton, *A Collection of Letters for the Improvement of Husbandry and Trade,* no. xii, Jan. 16, 1683. This would come under Bacon's entry in the catalogue of trades (*Works,* IV, 269) for a "History of Baking, and the Making of Bread."

[69] In *The Miscellaneous Writings,* p. 353.

[70] In the second edition of *Sculptura,* p. xxxi.

much of Evelyn's endless and apparently random virtuosity was directed towards a single goal.

We have now seen, as prophesied, that Evelyn's choice of trades falls under the "polite" or "more Liberall" categories.[71] After 1664, however, when the formation of a committee for "Histories of Trade" stimulated fresh interest, the trend was more and more toward the "Usefull & Vulgar." A catalogue was finally drawn up, and in December the members were invited to choose such trades "as they would give the history of."[72] By 1667, when Sprat reviewed the progress, plans of vast scope had been formed and considerable work accomplished:

> They have propounded the composing a *Catalogue* of all *Trades, Works,* and *Manufactures,* wherein Men are employ'd; in order to the collecting each of their Histories, by taking notice of all the physical Receipts or Secrets, the Instruments, Tools, and Engines, the manual Operations or Slights, the Cheats and ill Practices, the Goodness, Baseness, and different *Value* of Materials, and whatever else belongs to the Operations of all *Trades.*[73]

The following paragraphs refer to plans already under way for the "*Manufacture of Tapestry;* the improving of *Silk-making:* the propagating of *Saffron:* the melting of *Lead-Oar* with Pit-coal"; the study of soils and clays "for the better making of *Bricks* and *Tiles*"; and the culture of potatoes. And this list is later expanded by another which includes the histories of iron-making, tinneries and tin-working, lead, saltpeter, brass, varnish, cloth, leather, marble paper, hats, bread, and a host of others. (*Ibid.,* 258.) After sample specimens, one of which is Petty's *Apparatus to the History of the Common Practices of Dying* (*ibid.,* 284–301), Sprat closes with a glowing prophecy (*ibid.,* 310):

> They have assured grounds of *confidence,* that when this attempt shall be compleated, it will be found to bring innumerable benefits to all practical *Arts:* When all the secrets of *Manufactures* shall be discover'd, their *Materials* describ'd, their *Instruments* figur'd, their *Products* represented: It will soon be determin'd, how far they themselves may be promoted, and

[71] In his design for a library, above, p. 51.

[72] Birch, I, 407, for the creation of the committee on March 30, 1664. It included Boyle, Evelyn, Merret, and Petty. On June 8th, Merret was made chairman (I, 439) and fortnightly meetings were arranged. At the Dec. 7th meeting (I, 502, where the quotation appears), Seth Ward said he had seen a printed catalogue of trades, but if this is not Bacon's, I have found no trace of it.

[73] Sprat, *History of the Royal Society,* p. 190.

what new consequences may thence be educ'd. . . . In short, by this help the worst *Artificers* will be well instructed, by considering the *Methods*, and *Tools* of the best: And the greatest *Inventors* will be exceedingly inlighten'd; because they will have in their view the labours of many men, many places, and many times, wherewith to compare their own.

V

Ever since 1647 Robert Boyle had been offering encouragement and suggestions to others; in 1671 he spoke out himself. The quickened interest of the years from 1664 to 1667 had again died down; the scattered and desultory work of the virtuosi needed more concentration, firmer conviction, fresh stimulus. Ignoring catalogues and specific plans, Boyle wrote the finest apology we have for the History of Trades as an idea, gathering up into a rounded essay the full range of its meaning for his time. Because he was a scientist, and Bacon's greatest disciple, he reaffirmed its highest function, long subordinated, even in the Royal Society, to considerations of trade and industry:

For I look upon a good history of trades, as one of the best means to give experimental learning both growth and fertility, and like to prove to natural philosophy what a rich compost is to trees, which it mightily helps, both to grow fair and strong, and to bear much fruit.[74]

But because he was defending science in an age of commercial expansion, Boyle looked also to its immediate practical application:

I have often wished, that some ingenious friends to experimental philosophy would take the pains to enquire into the mysteries, and other practices of trades, and give us an account, some of one trade, and some of another, . . . towards the melioration of the professions they write of. (*Ibid.*)

Balancing these values in complementary sections, he composed his essay, *That the Goods of Mankind may be much increased by the Naturalist's Insight into Trades.*[75]

As we might expect, the first section on the contribution of trades to a natural history, is little more than an elaboration of Bacon's pregnant suggestions. Quite possibly with Evelyn in mind, Boyle reproves the childish disdain of learned men to converse with "illiterate mechanicks" in their workhouses and

[74] *Works*, III, 449. I give the title of the tract just below in the text.

[75] Essay IV in *Some Considerations Touching the Usefulness of Experimental Natural Philosophy . . . The Second Tome* (1671), in *Works*, III, 442–456.

shops.[76] For it is there that we find "nature in motion, and that, too, when she is (as it were) put out of her course"—Bacon's "nature wrought or altered"—and consequently most instructive. (*Ibid.*, 443.) Because by 1670 such conditions could often be reproduced in laboratories, largely non-existent in Bacon's time, Boyle does not argue that factories alone could supply mechanical data. Instead, by contrasting tradesmen in their shops with the virtuosi in their laboratories, he brings out the continued importance of the former for the advancement of science. For one thing, they are more diligent than other "experimenters" since their livelihood is at stake; and if their observations are less accurate than those of learned men, "that defect is recompensed by their being more frequently repeated, and more assiduously made, than most of the experiments, wherein men of letters have furnished natural history." Or again, want of tools and accommodation will often force a craftsman to discover "new uses and applications of things," otherwise hardly found out by "even a knowing man." And finally, workshops contain many things "unknown to classical writers"—Boyle himself has learned more about stones from "two or three masons, and stone-cutters, than ever I did from *Pliny*, or *Aristotle* and his commentators." In fact, their very ignorance of books and the theories of the schools, makes tradesmen examine "the things they deal with, by mechanical ways,"—ways that seem extravagant to a "bookman," but prove true and useful to the scientist.[77]

In these last remarks we notice an attitude familiar enough today, but one which was just emerging in the middle of the seventeenth century, the disdain of the scientist for the "bookman." It is the extreme form of a general tendency of thought. The attack on pedantry in Montaigne and such English disciples as Feltham, Osborne, and Locke, leads to the subordination of reading to observation of the social world. In Comenius and his followers, the study of things, the phenomena of nature and crafts, is opposed to the long discipline in grammar and rhetoric. But the extreme position is found among the Baconians, with their passion for empirical knowledge. Petty boasted to Aubrey that he had read little since he was twenty-five, for "had he read much, as some men have, he had not known so much as he does, nor should he have

[76] *Ibid.*, 442, 443. For Evelyn's attitude, see above, p. 48f.

[77] All quotations are on pp. 443–444, *op. cit.*

made such discoveries and improvements.''[78] It is this conviction which makes him claim, in the *Advice to Hartlib,* that a man educated in the Gymnasium Mechanicum ''would certainly prove a greater scholar than the walking libraries so called, although he could neither write nor read.''[79] It is a kind of scientific primitivism. And Boyle shares this view to an unexpected extent. Speaking of his studies in anatomy with Petty, ''I have seen,'' he says, ''especially in the dissections of fishes, more of the variety and contrivances of nature . . . than all the books I ever read in my life could give me convincing notions of.''[80] Or, in another field, the writing of meditations, he finds a great difference between ''him that but takes up instructions in books of morality and devotion, and him that by occasional reflections derives them from the book of nature.''[81] It is not surprising that Evelyn found Boyle's library to be small, ''as learning more from men, real experiments, & in his laboratory (which was ample and well furnished), than from books.''[82] And sometimes, as we have just seen, the men were workmen, and the laboratory, their shops. In short, to people like Petty and Boyle, strongly suspicious of traditional knowledge, even to the point of actual distaste for reading, the direct study of manual arts took on special validity and special appeal.

We need not pause on Boyle's arguments in section two. Starting again from Bacon, he illustrates how practices in one trade may be applied by analogy to the improvement of another—if and when a group of scientists will set themselves methodically to a collection of mechanical histories. By way of example, he refers the reader to a specimen of his own, a history of the trade of varnish; mentions Italian accounts of particular professions which, like Merret's translation of *De Arte Vetraria,* should be made English; and begs all the virtuosi of our country ''not to disdain to contribute their observations to the history of trades.''[83] And

[78] *Letters Written by Eminent Persons* (1813), II, 486.

[79] In *The Harleian Miscellany,* VI, 146–147.

[80] *Works,* VI, 55, in an undated letter to Clodius, Hartlib's son-in-law.

[81] *Occasional Reflections upon Several Subjects* (1665), in *Works,* II, 340.

[82] *Diary,* III, 485, in a letter to Wotton, Mar. 30, 1696.

[83] *Works,* III, 449. See above, p. 52, and p. 47 for Boyle's earlier interest in the history of varnish. He promises to give this specimen "at the close of this essay," but I cannot find it there or anywhere else.

then, to emphasize its importance, Boyle inserts a sentence of autobiography (*ibid.*, 450) which throws further light on his activities before the Restoration:

> I once designed, if the publick calamities of my country had not hindered, to bind several ingenious lads apprentices to several trades, that I might the better, by their means, both have such observations made as I should direct, and receive the better historical accounts of their professions, when they should be masters of them.

And so, like Bacon's and Petty's and Evelyn's, Boyle's design was never achieved, and the History of Trades remains unwritten. Its scope was too vast; its promoters were virtuosi, men of a thousand interests, unfitted for the prolonged concentration demanded; its contribution to science was no longer needed when laboratories increased in number and efficiency, and when the method of hypothesis supplanted the mere collection of experimental data. It remains, however, of real historical importance. For almost a hundred years the History of Trades was an idea closely associated with the progress of science, education, and society. And without recognizing its influence, we cannot fully appreciate the work of Bacon and the Royal Society, of Petty, Evelyn, and Boyle.[84]

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[84] Since this article was written, Francis R. Johnson has published his "Gresham College: Precursor of the Royal Society," *Journal of the History of Ideas*, I (1940), 413–438, which definitely shows that long before the "Invisible College" of 1645, a cooperative group of scientists was centered at Gresham College. My statement, therefore, on p. 48 needs qualification; but my claim that Bacon's influence first became active about that time is unaffected by Mr. Johnson's evidence, since the men he discusses were apparently indifferent to Bacon's work.

BOYLE AS ALCHEMIST

By Louis Trenchard More

It has been generally known that Robert Boyle was an alchemist; that he accepted, theoretically and practically, the doctrine of the transmutation of the elements; and that he was convinced he had solved the problem. But unless his two neglected tracts on the subject and the scattered references to it throughout his works are collected and studied, one is apt to overlook what an obsession it was. The biographers and admirers of Newton attempted to save his reputation, as they thought, by suppressing the evidence of his interest in alchemy, or by asserting that he was attempting only to expose its charlatanry. Boyle's biographers cannot be accused of a like policy; but, in their emphasis on his institution of modern chemistry, they neglected to bring out how steadily he clung to the Scholastic sciences.

In February, 1675/6, Boyle sent a communication to the Royal Society with the title, "An experimental discourse of quicksilver growing hot with gold."[1] This paper excited wide interest among the members because, while the author did not claim to have accomplished the "projection" of gold, he boldly asserted he had so purified quicksilver into an essential mercury that it approached the Hermetic *prima materia,* and consequently he was in sight of a solution of the problem of transmutation. Such a confident assertion by Boyle, whose reputation was challenged only by that of Paracelsus and van Helmont, carried great weight.

Boyle stated in this paper that as early as 1652 he had, by God's blessing, obtained a mercury from quicksilver which, when he mixed it with pure and pulverized gold in the palm of his hand, the paste quickly became appreciably hot. This incalescence, as it was called, was generally regarded as a fundamental quality of the essence or soul of mercury. But he confessed that he had not attained to pure "projection,"[2] since he had had to use almost

[1] *Phil. Trans.,* Vol. XI, no. 122, pp. 515–533. Republished in *Works,* (Birch ed., 1772) Vol. IV, pp. 219–230.

[2] The alchemistic term for the use of a minute quantity of the transmuting agent which would change great quantities of metals suddenly into gold and, like a catalytic agent, could be used repeatedly, as it experienced no change.

equal quantities of gold and his mercury. But he emphasized its intense activity: "That, which makes this incalescence the more considerable is, that being willing to husband my mercury, a great part of which had been, as I guessed, stolen from me before I employed it, I made these trials but with a drachm at a time, which scarce amounts in quantity to the bigness of half a middle-sized bean; whereas, if I could have made the experiment with a spoonful or two of quicksilver, and a due proportion of gold, it is probable the heat would have been intense enough, not only to burn one's hand, but perchance to crack a glass vial."[3]

The reasons which determined Boyle to conceal so important a discovery for twenty-four years were that he wished to make sure of it by repeated trials and by constantly improving his processes, and that he feared its effect on society if it were divulged. Thus: "One of the chief reasons, that makes me backward to have the foregoing observations communicated to the curious, is, that I fear, we may thereby procure divers queries and perhaps requests, (relating to this mercury) which I would by all means avoid, for divers reasons, and particularly for this, that a great weakness of that part disables me to write with my own hand [his paralysis], and I know, you will not think it fit I should, about such a subject, employ an amanuensis."

Like all alchemists, Boyle did not publish his method of preparing this mercury because, as may be possible, he had secret doubts of its success, or because he wished to enjoy the usufructs of his discovery, or because he feared a consequent convulsion in society. As for the third influence he, like Paracelsus, thought that what the philosopher's stone "may do in physic, is likely much to exceed the political inconveniences, that may ensue, if it should prove to be of the best kind, and fall in ill hands. The knowledge of the opinions of the wise and skilful about this case will be requisite to assist me to take right measures in an affair of this nature. And, till I receive this information, I am obliged to silence."[4]

[3] Boyle was pursued by ill-luck: ignorant servants threw away his important products or they were stolen; notes and manuscripts were mislaid, destroyed, or stolen; and twice his only reliable operator died suddenly at a crucial time.

[4] It is impossible to know what this purified quicksilver was, for amalgams of gold and mercury produce very little heat. Perhaps some corrosive agent was not completely removed and caused a sensation of heat to the hand.

Boyle, probably, was induced to publish this discovery because the Royal Society had for some years been experimenting with the same problem and he might lose priority of discovery. Oldenburg had written to him, as early as February 1667/8, that he had forgot to mention the experiment about filling the pores of gold: "It is aimed at, to try whether the pores of that metal, for all its compactness, will admit mercury into them; and whether there may be a substance compounded of two, that shall be heavier when mixed, than both of them asunder."

Boyle's paper on the incalescence of gold is important also since it brought out a letter of criticism and advice from Newton, and was the cause of a certain amount of correspondence between them. Newton, to be sure, was known to Boyle by reputation; because, when he sent his great monograph *On the nature of light* to the Royal Society, Boyle, with Hooke and Bishop Ward of Salisbury, was requested to read it and report to the Society. The first record of their meeting was not till four years later when, in a letter to Oldenburg, dated 14 December, 1675, Newton wrote:

> Pray present my humble service to Mr. Boyle, when you see him, and thanks for the favour of the converse I had with him at spring. My conceit of trepanning the common ether, as he was pleased to express it, makes me begin to have better thoughts on, that he was pleased to entertain it with a smile.[5]

Newton was, at that time, also an ardent alchemist, and he was so excited by Boyle's "incalescing mercury" that, for the first and only time in his life, he ventured an enthusiastic criticism of the work of another man. In a letter to Oldenburg he wrote:[6]

> Sir, Cambridge, April 26, 1676.
>
> . . . .
>
> Yesterday I, reading the two last Philosophical Transactions, had the opportunity to consider Mr. Boyle's uncommon experiment about the incalescence of gold and mercury. I believe the fingers of many will itch to be at the knowledge of the preparation of such a mercury, and for that end some will not be wanting to move for the publishing of it, by urging the good it may do in the world; but in my simple judgement the noble author, since he has thought fit to reveal himself so far, does prudently in being reserved in the rest. Not that I think any great excellence in such a mer-

[5] *Macclesfield Collection*, Vol. II, p. 375.

[6] *Ibid.*, p. 395. Also *Works*, Vol. I.

cury, either for medical or chemical operations.[7] . . . If this analogy of these two kinds of liquors may be allowed, one may guess at the little use of the one by the indisposition of the other, either to medicine or vegetation. But yet because the way, by which mercury may be so impregnated, has been thought fit to be concealed by others that have known it, and therefore may possibly be an inlet to something more noble, not to be communicated without immense damage to the world, if there should be any verity in the Hermetic writers, therefore I question not but that the great wisdom of the noble author will sway him to high silence till he shall be resolved of what consequence the thing may be, either by his own experience, or the judgement of some other, that thoroughly understands what he speaks about, that is, of a true Hermetic philosopher, whose judgement (if there be any such) would be more to be regarded in this point than that of all the world beside to the contrary, there being other things beside the transmutation of metals, (if those great pretenders[8] brag not) which none but they understand. Sir, because the author seems desirous of the sense of others in this point, I have been so free as to shoot my bolt; but pray keep this letter private to yourself.

Your servant, Is. Newton.

Newton's character is vividly contrasted with that of Boyle in this letter. While Newton uses the language of the alchemists, his essentially critical nature makes him first seek an explanation in the ordinary reactions of chemical agents. Nor does he believe that Boyle has obtained valuable results but, since alchemists claim to know great secrets, they may now be induced to publish them; till then, it is wise for Boyle to preserve a "high silence." And lastly, there is that characteristic and exasperating touch, so persistent in Newton's secretive character, of requesting his opinion to be kept private. No one acquainted with Oldenburg's garrulous and even meddlesome disposition, and his intimacy with Boyle, will believe for a moment that he did not communicate this letter. Miss Masson[9] states in her life of Boyle that: "Newton's 'bolt' took

[7] In explanation of this opinion, he argues that the metalline particles impregnated in Boyle's mercury may not have a peculiar and subtle quality but because being grosser than the particles of mercury, they may give a greater shock and motion to the particles of the gold, and so heat it. If so, then the action of Boyle's prepared mercury is merely similar to the heat caused by a corrosive liquor, as *aqua fortis*.

[8] It should again be pointed out, as was done in my *Life of Newton*, that his use of the word "pretenders" did not imply that he considered them to be impostors as Brewster alleged. On the contrary, it was used at that time as equivalent to our professor of chemistry.

[9] Masson, *Life of Boyle*, p. 289.

effect, though it must have cost Boyle something to give up that little bit of research." The "bolt" was too caustic and too sound, not to have chilled the enthusiasm and confidence of Boyle. But it is easy to prove that, far from giving up that "little bit of experiment," which was in reality as great a prize in chemistry as was gravitation in physics, he cultivated it doggedly during the rest of his life.

The immediate effect of the "bolt" was that Boyle, instead of becoming hurt and angry at the presumption of a young man who had thus confidently reversed the rôle of Mentor to him then at the height of his reputation, must have sought an interview and have asked for his opinion on the corpuscularian hypothesis in general, and of transmutation in particular. There is no other way to account for the extraordinary letter—extraordinary in length and in freedom from restraint—which Newton wrote to him on February 28, 1678/9.[10] In this letter, after apologizing for engaging in such speculations which were mere guess-work and not science, he explains in detail the hypothesis that the cause of many of the phenomena of light, of most chemical operations, including Boyle's incalescence of gold, and even of gravitation, was to be found in a universal ether.

We have no knowledge of Boyle's reaction to Newton's letter, since his answer, if he made one, has not been found; but the hypothesis was so consonant with his own, that its influence can be traced in his later speculations. There is no evidence of further meetings or correspondence between the two men. Newton, during his rare visits to the Royal Society, may have met him and probably did, but when he went to live in London, Boyle had been dead for some years.

Newton was to learn from experience that his "bolt" and his warning against hypothesis were in vain; so difficult, so very difficult, it is to wean the affection of a doting father from these children of his mind. Within two years of his "bolt" and in the same year as his letter on the ether, Boyle published, in 1678, a short tract with the title, "An historical account of a degradation of gold, made by an anti-elixir: A strange chymical narrative."[11] The work, like so many others by Boyle, is written as a philosophic dia-

[10] First published, *Works,* Vol. I, pp. cxii–cxvii. Reprinted, *Macclesfield,* Vol. II, pp. 407–419. Excerpted, More, *Life of Newton,* pp. 211–215.

[11] *Works,* Vol. IV, pp. 371–379.

logue and, although he published it anonymously, the use of the name Pyrophilus as the chief speaker, easily identified the author.

One could wish that Boyle had never published this paper, for it descends to the tricks and mystifications of the charlatan. Pyrophilus introduces the subject of the dialogue with the apology: "I cannot remove all your doubts and objections, or my own, by being able to affirm to you, that I have with my own hands made a projection, (as chemists are wont to call the sudden transmutation made by a small quantity of their admirable elixir) yet I can confirm much of what hath been argued for the possibility of such a sudden change of a metalline body, by a way, which, I presume, will surprise you; for, to make it more credible, that other metals are capable of being graduated, or exalted into gold, by way of projection, I will relate to you, that by the like way gold has been degraded, or imbased."

The company having expressed a proper surprise, Pyrophilus proceeds to tell them that a stranger, meeting him in the lodging of a virtuoso, entertained him with tales of the wonders he had met with in many foreign lands. Pyrophilus asks him whether he had met with any chemists in the eastern parts: "He answered me, that he had; and that though they were fewer, and more reserved than ours, yet he did not find them at all less skilful. And on this occasion, before he left the town to go aboard the ship he was to overtake, he in a very obliging way put into my hands, at parting, a little piece of paper, folded up, which he said contained all that he had left of a rarity he had received from an eastern virtuoso, and which he intimated would give me occasion both to remember him, and to exercise my thoughts in uncommon speculations."[12]

In the packet of paper there was discovered about an eighth of a grain of a *darkish red powder:* note this red earth,[13] as it will turn up later under different circumstances, as a coveted product of Boyle's own making. Having begun with all the trappings to excite, and to deceive, the credulous, Pyrophilus takes every precaution to have unbiased witnesses and to use scrupulous care. Two drachms of refined gold were melted in a new crucible without the use of borax and then, with his own hands, the magic powder was introduced. He finally poured the well-melted gold into another crucible. He "was somewhat surprised to find, when the

[12] *Works,* Vol. IV, p. 374.

[13] This red earth is perhaps an impure oxide, or sulphide, of mercury.

matter was grown cold, that though it appeared upon the balance, that we had not lost anything of the weight we had put in, yet, instead of fine gold, we had a lump of metal of a dirty colour, as it were overcast with a thin coat, almost like half vitrified litharge; and somewhat to increase the wonder, we perceived, that there stuck to one side of the crucible a little globule of metal, that looked not at all yellowish, but like coarse silver, etc."[14] The company is convinced that Pyrophilus's magic elixir actually degraded pure gold into true silver; and he closes the dialogue with this cryptic and tantalizing sentence: "As extraordinary, as I perceive most of you think the phenomena of the lately described experiment; yet I have not (because I must not do it) as yet acquainted you with the strangest effect of our admirable powder."

Boyle was undoubtedly credulous; or, perhaps, we should say, as did Herschel, that he had an "undistinguishing appetite." He could readily believe in transmutation and search for the philosopher's stone as eagerly as another; probably, not to acquire wealth, since he had a sufficiency all his life, but for the mystery and excitement of the chase. There was, however, a strong, practical reason for seeking to solve the problem, dear to his heart, and that was a supposed benefit to medicine. Paracelsus had proclaimed the discovery of an alkahest, a liquid more potent than the philosopher's stone, which would be of marvelous excellence as a medicine.[15] For that reason, Boyle had been willing to publish the recipe for his incalescing mercury, if he were advised to do so, because its blessing as an universal nostrum would outweigh any possible disturbance to society.

Besides these two works, specifically on transmutation, there are numerous references to the subject scattered throughout his writings. Like all renowned alchemists, Boyle had compounded his own wonder-working agent which he had named, a *menstruum*

[14] *Works*, Vol. IV, p. 375.

[15] The belief in the alkahest of Paracelsus was general; Van Helmont elevated it into an universal solvent, revealed by God to the elect only. Nor was its existence questioned. Kunckel, in his *Laboratorium Chymicum*, pointed to the obvious fact that an alkahest could not be discovered, because such a liquid would dissolve any vessel in which it was prepared. Then he added, Paracelsus is said by some to have coined the name from *alkali est*; by others, that he derived it from *der all Geist*; by others, from *alles ist*. But alkahest is merely another form of *alles Lügen heisst* or *alles Lügen ist*.

peracutum. As early as 1666, in his important treatise on *The Origin of Forms,* he gives its recipe and examples of its potency: "Made by pouring on the rectified oil of the butter of antimony as much strong spirit of nitre, as would serve to precipitate out of it all the *bezoarticum minerale;* and then with a good smart fire distilling off all the liquor that would come over, and (if need be) cohobating it upon the antimonial powder."[16] Then he proceeds: "Having then provided a sufficient quantity of this liquor (for I have observed that gold ordinarily requires a more copious solvent than silver) we took a quantity of the best gold we could get, and melted it with three or four times its weight of copper, which metal we choose rather than that which is more useful among refiners, silver, that there may be the less suspicion that there remained any silver with the gold after their separation: this mixture we put into good aqua fortis or spirit of nitre, that all the copper being dissolved, the gold might be left pure and finely powdered at the bottom; this operation with aqua fortis being accounted the best way of refining gold that is yet known, and not subject like lead, to leave any silver with it, since the aqua fortis takes up that metal. And for greater security we gave the powder to an ancient chemist to boil some more of the menstruum upon it, without communicating to him our design. This highly refined gold being by a competent degree of heat brought, as is usual, to its native colour and lustre, we put to it a large proportion of the *menstruum peracutum* (to which we have sometimes found cause to add a little spirit of salt to promote the solution) wherein it dissolves slowly and quietly enough; and there remained at the bottom of the glass a pretty quantity (in shew, though not in weight) of white powder that the menstruum would not touch; and, if I much misremember not, we found it as indissolvable in aqua regia too." Finally, Boyle fluxed the powder, and obtained a white metal, which he confirmed, to his satisfaction, to be true silver.[17] He did repeat the experiment once,

[16] *Works,* Vol. III, p. 94.

[17] In modern terms, Boyle's menstruum was impure aqua regia with an excess of nitric acid, since to increase its action on gold he often added hydrochloric acid. The reaction: Butter of antimony is its chloride, and adding to it nitric acid, the basic salts of antimony, and probably some of its acids, will be precipitated, *i.e.,* the bezoarticum minerale; the liquor distilled off is a mixture of nitric and hydrochloric acids. While Boyle was acquainted with aqua regia he would not know that it could be obtained in this manner.—The white powder was the chloride of the silver originally alloyed with the gold or copper.

and again obtained the white powder which he washed and laid on a white paper to dry: "Being suddenly called out of my chamber, an ignorant maid, that in the meantime came to dress it up, unluckily swept this paper, as a foul one, into the fire; which discouragement, together with a multiplicity of occasions, have made me suspend the pursuit of this experiment till another opportunity."

This is an apparently straightforward account of a scientific experiment, in which the agents and processes are detailed, and the error lay only in the identification of the residual white powder as being silver; or, if it was silver, and Boyle seems to have been content with very superficial tests, then it must have been originally present in the gold or copper. No one can believe that he permitted the accident of an ignorant servant (these accidents are astonishingly frequent in the work of the alchemists) to stop further work with his anti-elixir. And the fact that he continued to work on the degradation of gold to silver, and to believe that he had achieved the ambition of the ages, is proved by his paper on *The Degradation of Gold* mentioned above, which was published twelve years later.

Also Boyle, as a consequence of being a corpuscularian, would regard transmutation as a necessary principle of nature. He had achieved a great victory in replacing the Scholastic doctrine of causal forms, as it was superficially understood in the seventeenth century, by a mechanistic cause. His corpuscular hypothesis, like all its variants from the atom of Democritus to the electron of today, is so simple in statement and yet so exasperating in results. All the different qualities of bodies are assumed to be merely different geometric patterns of aggregations of identical corpuscles, and every chemical analysis, or synthesis, is thus only a mechanical rearrangement of one pattern into another. If so, was it to be doubted that a chemist, with his planning mind and manipulative skill, could discover a chain of actions by which he would rearrange the pattern which was, for example, lead, into the pattern which is gold?

In his enthusiasm, like most philosophic innovators, Boyle had a vision of rearrangements of his corpuscular patterns as a universal principle of Nature; or rather, since he was a devout teleologist, as God's instrument of creation, shifting his patterns to serve his divine and omnipotent will. Consequently, he was receptive to the idea that special patterns of corpuscles were also the

stuff of life. In this belief, he anticipated Herbert Spencer by two centuries, who saw the beginning of life on the earth as merely a chance aggregating of atoms into an unusually complicated pattern, and all the subsequent varieties of life as shifts in their geometric arrangement. The only difference between the two was, that Boyle believed the cause of such variations to be the inscrutable hand and mind of God; and Spencer conceived them as an inexorable law of mechanics, instituted we know not how, but apparently only as a result of chance.

Thus Boyle, to substantiate his hypothesis, was eager to collect evidences of transmutation by personal experimentation and observation, and from reports of others. It will suffice to give an account of his experimental proof of water changing into an earth, and two or three reports of transformations of animals and plants, taken from his monograph on *The Origin of Forms and Qualities*.[18]

Boyle was first led to investigate (or indagate, as he would say) the artificial transmutation of water into earth,[19] after he had been consulted "by an ancient chymist but not at all a philosopher" who, having employed a great quantity of putrified rain-water, obtained from it much less of what he looked for, but a great deal of a whitish excrementitious matter. Boyle, being interested, placed a quantity of distilled rain-water in a new and clean glass vessel and redistilling it, found, to his joy and surprise, "the bottom of the glass covered over with a white (but not so very white) substance, which being scraped off with a knife, appeared to be a fine earth, in which I perceived no manifest taste, and which, in a word, by several qualities seemed to be earth."

By chance, Boyle mentioned this experiment to a very ingenious person and one well versed in chemical matters, and was pleased to learn that he, too, had redistilled rain-water in clean glass vessels, "and near two hundred times, without finding that his liquor grew weary of affording him the white earth." This confirmation convinced them of a true transmutation. And was this opinion not justified, granting their postulate that glass was insoluble in water, and remembering that they had no test for, or knowledge of, silica?

The following illustrations of transmutation were cited by Boyle as collected by him from strange tales of wonderful animals and plants in foreign lands, the farther from home, the better.

[18] *Works*, Vol. III, pp. 1–137.
[19] *Works*, Vol. III, p. 102.

And, in those days of imagination, he accumulated a rich harvest.

"For coral, to pass by all other plants of that kind that may be mentioned to the same purpose, whilst it grows in the bottom of the sea, is a real plant, and several times (which suffices for my present scope) hath been there found by an acquaintance of mine, as well as by other enquirers, soft and tender like any other plant: nay, I elsewhere bring very good and recent authority to prove that it is oftentimes found very succulent, and does propagate its species as well as other shrubs; and yet coral being gathered and removed into the air, by the recess of its soul, no new lapidific form being so much as pretended to, turns into a concretion, that is by many eminent writers, and others, reckoned among lapideous ones."[20]

Of transmutation of animals into stone, Boyle quotes this example from an eye witness of authority: "I saw in a small fresh-water and shallow lake of the island Hainan (which belongs to China) crabs or craw-fishes, which, as soon as they were drawn out of the water, did in a moment lose both life and motion, and became petrified, though nothing appeared to be changed either in the external or internal figure of their bodies."[21]

Two examples of transmutations between animals and plants may also be cited: "The industrious Piso, in his excellent history of Brazil, vouches a multitude of witnesses (not having an opportunity to be one himself) for the ordinary transformation of a sort of animals (not much unlike grasshoppers) into vegetables, at a certain season of the year." And the following from an eye-witness, Sir James Lancaster, in his own words, is even more pertinent: "Here (says he, speaking of the coast of Sombrero) we found upon the sand by the sea side a small twig growing up to a young tree; and offering to pluck up the same, it shrunk down into the ground, and sinketh unless you hold very hard. And being plucked up, a great worm is the root of it: and look how the tree groweth in greatness, the worm diminisheth. Now as soon as the worm is wholly turned into the tree, it rooteth in the ground, and so groweth to be great. This transformation was one of the greatest wonders I saw in all my travels. This tree being plucked up a little, the leaves stripped off, and the peel, by that time it was dry, turned into a hard stone, much like white coral. So that this worm

[20] *Works,* Vol. III, p. 59.
[21] *Works,* Vol. III, p. 60.

was twice transformed into different natures: of these we gathered and brought home many."[22]

This last example of transmutation so impressed Boyle that he transmitted it to the Royal Society with the request it be investigated. They, in turn, invited the English Agent in Sumatra to report as to its truth. The Agent, after some delay, wrote that he had not found any one who had, himself, seen the shrub, but he had met several who knew persons that had seen it: and there the investigation seems to have ended.

There is no doubt that Boyle, after he left Oxford for London, continued to work on his "mercury" and his "red earth" in connection with the multiplying of gold and with ever increasing hope of success. Besides his lodgings and his personal laboratory in Pall Mall, he also maintained other lodgings in the city to which he occasionally retired when distracted by visitors, and he owned and operated a large commercial laboratory. From the prints of this laboratory which have fortunately been preserved, it was well equipped with apparatus and workmen. Boyle seems to have conducted the business as a company, manufacturing and selling the common products in use, and enjoying a monopoly in making phosphorus; here, also, were carried on his attempts to multiply gold.

Boyle became so confident of success in transmutation that he petitioned Parliament, and succeeded in having the Act of Henry IV against "multipliers of gold" repealed. This we know from a letter to a Mr. Christopher Kirkby of date, 29 April, 1689: "I shall, without hesitation, assure you, that I have long been, and still am, of opinion, that the act of Henry IV has been, and, whilst it shall remain in force, will be, a great discouragement to the industry of skilful men, which is very happily improved in this inquisitive age. And therefore, that the repealing of a law, so darkly and ambiguously penned, will much conduce to the public good, and be in particular advantageous to the counties of Cornwall and Devonshire, where tin so much abounds, that it is (as you well know) a drug." The clause of the act repealed was: "That none from thenceforth should use to multiply gold or silver, or use the craft of multiplication; and if any the same do, they should now incur the pain of felony." The new act provided that all gold and silver extracted by melting and refining of metals and

[22] *Works*, Vol. III, p. 60.

"otherwise improving of them and their ores" shall be used only for increasing money and be deposited at the royal mint in the Tower of London. It finally provided that no mine of copper, tin, iron, or lead, shall be reputed to be a royal mine, even though gold ore be extracted from it.[23]

Some further knowledge of Boyle as a "multiplier" is obtained, in an unexpected way, from a correspondence between John Locke and Newton.[24] After Boyle's death, his manuscripts and notes on chemistry were entrusted to Locke who was, himself, an able chemist. He evidently found amongst them Boyle's recipes for his "mercury" and his "red earth." Doubtful of their meaning or of their value, he wrote to Newton for advice. A month after Boyle's death, Newton replied: "I understand Mr. Boyle communicated his process about the red earth and mercury to you as well as to me, and before his death, procured some of that earth for his friends." And again the following month: "Mr. Pawling told me, you had writ for some of Mr. Boyle's red earth, and by that I knew you had the recipe."

What Boyle wished Locke to do with the recipe is not known. But Locke, who was then editing a *General History of the Air, by the Right Hon. Robert Boyle,* evidently began to work on the recipe, for Newton wrote to him a long letter of advice. This letter gives such an extraordinary account of the whole queer proceedings that it is quoted in full.

Sir, August 2d, 1692.

I beg your pardon that I sent not your papers last week; the carrier went out a quarter of an hour sooner than I was aware of. I am glad you have all the three parts of the recipe entire; but before you go to work about it, I desire you would consider these things, for it may perhaps save you time and expense. This recipe I take to be the thing for the sake of which Mr. Boyle procured the repeal of the Act of Parliament against Multipliers, and therefore he had it then in his hands. In the margin of the recipe was noted, that the mercury of the first work would grow hot with gold, and thence I gather that this recipe was the foundation of what he published

[23] *Works,* Vol. I, p. cxxxii.

[24] Lord King's *Life of John Locke,* Vol. I, pp. 388–423. Their correspondence began in 1688, and the first letter of Newton's is a proof, different and simpler than the one in the *Principia,* that the planets, because of gravity towards the sun, may move in ellipses. Most of the letters are on biblical interpretation or personal matters; only three refer to Boyle. Although we have only the letters by Newton, it is not difficult to guess Locke's questions.

many years ago, about such mercuries as would grow hot with gold, and therefore was then known to him, that is, sixteen or twenty years ago, at least; and yet, in all this time, I cannot find that he has either tried it himself, or got it tried with success by any body else: for, when I spoke doubtingly about it, he confessed that he had not seen it tried; but added, that a certain gentleman was now about it, and it succeeded very well so far as he had gone, and that all the signs [of transmutation] appeared, so that I needed not doubt of it. This satisfied me that mercury, by this recipe, may be brought to change its colours and properties, but not that gold may be multiplied thereby; and I doubt it the more, because I heard some years ago of a company, who were upon this work in London, and after Mr. Boyle had communicated his recipe to me, so that I knew it was the same with theirs. I inquired after them, and learnt that two of them were since forced to other means of living; and a third, who was the chief artist, was still at work, but was run so far into debt that he had much ado to live; and by these circumstances, I understood that these gentlemen could not make the thing succeed. When I told Mr. Boyle of these gentlemen, he acknowledged that the recipe was gone about among several chymists, and therefore I intend to stay till I hear that it succeeds with some of them.

But, besides, if I would try this recipe, I am satisfied that I could not, for Mr. Boyle has reserved a part of it from my knowledge. I know more of it than he has told me; and by that, and an expression or two which dropped from him, I know that what he has told me is imperfect and useless without knowing more than I do: and, therefore, I intend only to try whether I know enough to make a mercury which will grow hot with gold, if perhaps I shall try that. For Mr. Boyle to offer his secret upon conditions, and after I had consented, not to perform his part, looks oddly; and that the rather because I was averse from meddling with his recipe, till he persuaded me to it; and by not performing his part, he has voided the obligation to the conditions on mine, so that I may reckon myself at my own discretion to say or do what I will about this matter, though perhaps I shall be tender of using my liberty. But that I may understand the reason of his reservedness, pray will you be so free as to let me know the conditions which he obliged you to, in communicating this recipe; and whether he communicated to you any thing more than is written down in the three parts of the recipe. I do not desire to know what he has communicated, but rather that you would keep the particulars from me, (at least in the second and third part of the recipe) because I have no mind to be concerned with this recipe any farther than just to know the entrance. I suspect his reservedness might proceed from mine; for when I communicated a certain experiment to him, he presently, by way of requital, subjoined two others, but cumbered them with such circumstances as startled me, and made me afraid of any more: for he expressed that I should presently go to work upon them, and desired

I would publish them after his death. I have not yet tried either of them, nor intend to try them; but since you have the inspection of his papers, if you design to publish any of his remains, you will do me a great favour to let these two be published among the rest. But then I desire that it may not be known that they come through my hands. One of them seems to be a considerable experiment, and may prove of good use in medicine for analysing bodies; the other is only a knack. In dissuading you from too hasty a trial of this recipe, I have forborne to say any thing against multiplication in general, because you seem persuaded of it; though there is one argument against it, which I could never find an answer to, and which, if you will let me have your opinion about it, I will send you in my next.[25]

What became of this red earth and the recipe so cherished by Boyle that he had labored on them for almost forty years, we shall probably never know and really care little; but we would give much to discover Newton's unanswerable argument.

There were persistent complaints by Boyle of plagiarism of his writings; of misfortunes to his operations; and especially of the loss or theft of his manuscripts, of his mercury, and of his red earth. One would expect plagiarism of a popular writer, as it was a pretty common practice of the age; also accidents and misfortunes are frequent in chemistry; but loss and theft of an author's notes and manuscripts are another matter, as they are not usually of enough value to excite temptation. Is it not possible, and even probable, that rumors were widely spread of Boyle's possession of a recipe which would turn base metals into gold? Such a paper would certainly tempt the cupidity of assistants and visitors who might hope to find it included amongst manuscripts they could lay their hands upon. Some such explanation seems necessary to account for an extraordinary advertisement about the loss of manuscripts, addressed to J. W. and published in two pages in folio. As this advertisement appeared in 1688, the year before that in which he succeeded in having the Act against multipliers repealed, the coincidence is very striking. The portion pertinent to this guess is as follows:[26]

In the month of May 1688, I thought myself obliged to give notice to the public, that I had, partly by some men's fraud, and partly by mischance, lost so many of my essays and other tracts, and had so many of my remaining papers endamaged by corrosive liquors, that the curious were not thence-

[25] *Life of Locke,* Vol. I, pp. 410–413.

[26] *Works,* Vol. I, p. cxxv.

forth to expect from me any thing but imperfect and mutilated. And yet since that time all my care and circumspection has not hindered me from losing six centuries of matters of fact in one parcel, besides so many papers of lesser bulk, that I am reduced to remind the curious of my former advertisement; not for any pleasure I take in complaining, or troubling others with my misfortunes, but to render a reason of the course I am by these misadventures driven to, though otherwise I should not think it eligible. This is to secure the remaining part of my writings, especially those that contain most matters of fact, by sending them maimed and unfinished, as they came to hand, to the press.

Being wont, when I first turned writer, to set down, as others use to do, my thoughts and observations on papers bound up into books, I was quite discouraged from that practice, by the losses I made at several times of manuscripts, which I strongly suspected to have been surreptitiously conveyed away by some, that though they expected to find valuabler things than I supposed they met with, would not probably have stolen away those papers, if their bulk had not been a main temptation to the theft.

Wherefore I afterwards resolved to write in single sheets, and other loose papers, that the ignorance of the coherence might keep men from thinking them worth stealing. And though I could not, by so doing, prevent the losing sometimes a paper or two by chance, or other men's fraud, yet I thought such inconveniencies (which I could sometimes easily repair out of my memory) much inferior to those of losing an entire discourse, or a whole discourse at a time. . . .

The remainder of the advertisement deals with the widely prevalent vice of plagiarism, and methods of prevention. However one regards it, the incident discloses an amazing state of affairs, and an equally amazing remedy. One would suppose some simpler method of safeguarding Boyle's papers could have been devised if, as is suggested, he knew that they included such tempting materials.

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HAZLITT'S CRITICISM AND GREEK SCULPTURE

By Stephen A. Larrabee

I

Even among his contemporaries William Hazlitt defied classification. Through a trust in the immediate perceptions of the senses he escaped, to a surprising extent, the dogmas of both the defenders of the Ancients and the champions of the Moderns. Most balanced, if most unclassifiable, of the Romantic critics, Hazlitt combined a large fund of common sense with an exceptional sensitivity. Not an originator of aesthetic theories like Coleridge; not a poet like Shelley rhapsodizing about the poetic power, nor like Wordsworth soberly defending the principles on which he worked, nor like Keats sprinkling critical dicta through his letters; not a crusty half-pedant like Landor, who studded his criticism with occasional profundity, Hazlitt was the practising critic among the Romantic writers, studious of the artistry of performance, catholic in interests, and varied in accomplishment—analyst and wise commentator on the theories of critics of greater genius, disseminator rather than originator of ideas, and splendid illustration of his own definition of Taste: "taste (as it relates to the productions of art) is strictly the power of being properly affected by works of genius."[1]

[1] "Thoughts on Taste," *Complete Works of William Hazlitt*, ed. P. P. Howe, after the edition of Waller and Glover (London, 1930–34), XVII, 57. In this essay the word *Romantic* refers to authors and works which belong to the Romantic period, the first third of the nineteenth century, roughly, from 1798 to 1832. The word "romantic" is used to connote the distinctive traits or beliefs of writers during that period. A "romantic" writer, I believe, concerned himself with expressing the "inner" or "essential" spirit of his age—a spirit which he discovered through his imaginative participation in, or sympathy with, its various activities. He shared all four of the aesthetic ideals which Professor Arthur O. Lovejoy has termed the "essentials of the aesthetic creed of Romanticism" (" 'Nature' as an Aesthetic Norm," *MLN.*, XLII, 1927, 450). Most important of these ideals, I feel, were: "expression of that which is most distinctive of, or most intimately familiar to, the artist and his immediate public" and "completeness of representation of human life or of aspects of the sensible world; expression of their 'fullness,' diversity and richness of contrasts"; Lovejoy, *op. cit.*, pp. 448–49. Thus, "romantic" is practically synonymous, as in Germany, with the peculiarly or distinctively "modern" (and Christian). It is therefore used as the opposite of "classical" or "ancient" (and Pagan), particularly in section III, where the familiar antithesis of the German Romantics appears in connection with A. W. Schlegel. (See also Lovejoy, "On the Discrimination of Romanticisms," *PMLA.*, XXXIX, 1924, 245–46.)

Hazlitt's remarks about the arts, moreover, have a peculiarly significant place in a study of the taste of the Romantic writers because he may be said to have "grown" into a love of literature and the fine arts. When scarcely ten years of age, he was already "hankering," as Haydon remarked of him later, to follow his older brother into the craft of painting. Predicting the wide-ranging interests of his maturity, the ambitious youngster wrote, "I shall not, I suppose, paint the worse for knowing everything else"[2]—a sentiment which would have pleased the Baconian poets and virtuoso-gentlemen of the seventeenth century who believed the artist should have command of all fields of human knowledge. In the charming essays "On the Pleasure of Painting" Hazlitt recorded that the exhibition of the collection of the Duke of Orleans in 1798–99 definitely sent him into the actual practice of the art and to the Louvre; but his own painting need not detain us long. Nor need one linger over the political and metaphysical writings by which the versatile writer first sought literary fame.

Strict chronology means little, of course, with such a repeater of ideas as Hazlitt; yet there is some value in marshalling his chief writings on the arts in the order of publication. As early as 1814 he was writing on the fine arts, especially painting, in *The Morning Chronicle;* in 1815 his work for *The Champion* firmly established him as a critic of art. Early in the following year, when the hearings in regard to the purchase of the Elgin Marbles began before a Parliamentary Committee, Hazlitt gladly entered the lists, joining Haydon in his attacks on the connoisseurs who preferred the familiar Greco-Roman antiques, such as the Apollo Belvedere. His contributions on the subject in *The Examiner* were slight, but they had a share in mobilizing support for the statuary. *The Champion* might be termed the organ for "the Committee in Defense of the Elgin Marbles."

By 1817 Hazlitt was so deep in aesthetic criticism that references to the fine arts began to appear with increasing frequency in his literary criticism also, for example, in the 1818–19 *Lectures on the English Poets.* Most important, in his own opinion, at least, of the essays up to and including *Table Talk* (1821) were the discussions of Beauty, Taste and the Picturesque—subjects which had

[2] See *Autobiography and Memoirs of Haydon,* ed. Tom Taylor (new ed. with introduction by Aldous Huxley, London, 1926), I, 160, and P. P. Howe, *The Life of William Hazlitt* (New York, 1923), p. 6.

interested many aestheticians in the eighteenth century, such as Jonathan Richardson, Senior, whom Hazlitt found still valuable, even wishing the essays of Richardson "better known." In other writings he broke lances with Sir Joshua Reynolds, to whom he was nevertheless in debt. Travelling about his own country at various times, he gathered his impressions of the important collections of art in *Sketches of the Principal Galleries in England,* printed in 1824. After visiting the Continent in 1824 and 1825, Hazlitt published in 1826 a chatty volume of *Notes of a Journey through France and Italy* containing his "soul-adventures" among masterpieces. In *The Conversations of James Northcote, Esq., R. A.,* published between 1826 and 1830, he appeared as a sort of Boswell of the art-world of his day. In 1829 it was his lot to review the Academy *Lectures on Sculpture* of John Flaxman, the friend of Blake and the great English sculptor of "Grecian" Outlines. Most of these works will find some place in this essay, but the major attention naturally falls on the *Travel Notes* and the essays on the Elgin Marbles, especially the two major papers in *The London Magazine* in 1822 (which included *The Examiner* articles of 1816), where Hazlitt revealed most clearly what the Romantic writers, poets and critics alike, valued in the sculpture of the ancient Greeks.

II

For one trained as a painter Hazlitt was unaccountably slow in arriving at an appreciation of sculpture. During his student days in Paris he somehow escaped the vogue of Canova and the classicistic artists who dominated the plastic arts. Of the many Englishmen who scurried to France after the Peace of Amiens in 1802, apparently he was the only one who failed to respond ecstatically to the Venus and the Apollo, then in the Louvre thanks to Napoleon. His indifference to classical sculpture was in striking contrast to the enthusiasm of the poet Thomas Campbell, for example, who gloried in the antiques thus:

> I could not command myself, and left Mrs. Siddons—glad to indulge the most absurd and pleasing of all tears. I know it is all *imagination.* Perhaps, unless told of it, I could not even discover that I really saw the statues that enchant the world—the prodigies of two thousand years!—such associations rushed upon me, that I thought myself transported into another world.[3]

[3] *Life and Letters of Thomas Campbell,* ed. William Beattie (London, 1849), II, 254.

No such rhapsodies crossed Hazlitt's lips, and no such revelations came to him during his first visit to Paris; nevertheless, when he visited the Louvre again in 1824, he easily assumed the rôle of man of feeling and wept over his favorite Poussins, lamenting that the "great" antiques (which he had scorned before!) had been sent back to Italy.

The Elgin Marbles, with which he became acquainted at the time his Lordship offered them to the nation, were the first works of sculpture to excite the interest of Hazlitt. Though he was not immediately overwhelmed by them as young Keats was, he too regarded them as a sort of new planet swimming into his ken. If one can take his own statement at its face value, he had never liked any statues till he saw the Elgin Marbles.[4] The first moderate praise of the Parthenon sculpture in *The Examiner* articles of 1816 eventually grew into a major enthusiasm for those masterpieces, Hazlitt considering them the highwater mark of the art of sculpture—no less, indeed, than "the paragons of sculpture and the mould of form." In short, he was in complete agreement with Haydon that the Elgin Marbles had put into shade all the antiques previously deemed beautiful. According to the standard of beauty revealed by the Theseus, Hazlitt maintained vigorously, the Apollo Belvedere was a theatrical coxcomb, the Venus an immodest minx, and the Hercules an over-developed athlete. In contrast to Byron, for example, who still preferred the Apollo and the Venus to what he termed the "maim'd antiques" from the Parthenon, Hazlitt turned to the Elgin Marbles as the finest statuary in existence.[5] Not content with praising the sculpture brought back by Elgin or with ridiculing those who disliked them, the critic went on to analyze what he thought were the reasons for their superiority to such works as the Venus, and in doing so formulated some of the fundamentals of his own general aesthetic doctrine.

The particular merits Hazlitt found in the Parthenon sculptures were four. First of all they refuted the theories concerning the "Ideal Beauty" and the abstract and generalized "middle

[4] See "On the Pleasure of Painting," *Works,* VIII, 16, and also *Notes of a Journey,* X, 164.

[5] For Hazlitt's criticism of Byron's descriptions of the Greco-Roman statues, see his review of *Childe Harold's Pilgrimage, Canto IV, Works,* XIX, 36–37. A similar attack appeared in *Notes of a Journey, Works,* X, 164–65. For the passages in Byron, see *The Curse of Minerva.*

form" propounded by Reynolds, especially in Discourse III; for Hazlitt saw in them a combination of grandeur of design and exactness of detail which exploded the fashionable notion that the two were incompatible. Benjamin R. Haydon read a similar lesson from the statues and taught it to Keats. Presumably *Hyperion*—epic in design but with its details carefully carved in the "naked Grecian" or sculptural manner—was to have proved the value of the position taken by this group interested in Greek sculpture.[6]

In the second place Hazlitt felt that the Elgin Marbles possessed a vitality and expressiveness lacking in the familiar antiques. While the art of sculpture as a whole, he perceived, tended to be static in its effects, the Greco-Roman figures in particular displayed perfect forms without any "pathos":

> It is for want of some such resting place for the imagination that the Greek statues are little else than specious forms. They are marble to the touch and to the heart. They have not an informing principle within them. In their faultless excellence they appear sufficient to themselves. By their beauty they are raised above the frailties of passion or suffering. By their beauty they are deified. But they are not objects of religious faith to us, and their forms are a reproach to common humanity. They seem to have no sympathy with us, and not to want our admiration.[7]

Written before Hazlitt began to use the Elgin Marbles to illustrate his theory that every form or shape should display a feeling or emotion with which the perceiver could "sympathize," the quotation summarized admirably the attitude of many Romantic writers toward the famous Greco-Roman sculpture worshipped by gentlemen of the eighteenth century. Gone was the reverence with which Winckelmann and Reynolds had adored the Antique. The static perfection admired in antiques during the eighteenth century—the many variations on Winckelmann's theme of "noble

[6] See *Letters of John Keats,* ed. M. B. Forman (Oxford University Press, 1931), I, 88, and Haydon, *op. cit.,* I, 235 ff. I treat critical problems of this kind at more length in a book (to be published soon) of studies of Greek sculpture in English poetry of the Romantic period.

[7] "On Poetry in General," *Lectures on the English Poets, Works,* V, 11. Hazlitt quoted *Paradise Lost,* VIII, 538–39, ingeniously using Milton's lines to show that the ancient statues were perfect in exterior form but lacking in vitality within. Coleridge and/or Wordsworth probably inspired these comments, especially the emphasis on the spirit within and on the impossibility of sharing the belief or faith behind the ancient forms.

simplicity and quiet grandeur'' still echoing throughout European aesthetics—failed to satisfy the most perceptive Romantic critics. Weighed in the balance of ''romantic'' taste, the Hellenistic works had been found wanting. For Hazlitt their reputed grandeur was both too reposeful and too grand: their ''noble simplicity'' was really a lack of expressiveness. He shared Coleridge's belief that a ''romantic'' (a Modern or Christian) found difficulty in appreciating imaginatively such works as the Venus and the Apollo.

Since Hazlitt agreed with Blake and Coleridge that form or shape must be expressive, he attempted to discover the internal or informing spirit which determines the external form or appearance. Applying this theory to the Elgin Marbles, he was convinced that their vitality and expressiveness resulted from what he called ''an internal machinery'' operating within the statues.[8] In other words, Hazlitt believed he was able to enter into the feelings and to share the emotions of the sculptured figures, much as Keats endowed with life the sculptural scenes and figures in *Endymion* and *Hyperion* and the *Ode on a Grecian Urn.* Expressive symbols, the Parthenon reliefs were living forms, with the external beauty springing directly from the emotions felt within. No Platonist and not much of an aesthetician, Hazlitt avoided delving deeply into the metaphysics of form, leaving such complicated problems as the relation of the inner or essential form to the outer or material form to Coleridge and the German Romantics. Like Keats, he was content merely to say that to him the best Greek statues were beautiful because they expressed so much emotional activity which he could share.

The third superiority of the Parthenon sculptures to the ordinary antiques was that they united genius and nature. Ever-critical of Reynolds because ''the scope and 'butt-end' of his theories [was] that [a work of art] should avoid coming in too close contact with nature,'' Hazlitt ridiculed the Academician's devotion to an abstract Ideal Beauty, even reverting to the early Renaissance theory of a literal Imitation of Nature to bolster his own contention. The vehemence of this assertion of the ''naturalness'' of the Elgin Marbles was intended to frustrate critics who wanted to carry the statuary away from flesh and blood human beings into the realm of Ideal Beauty. The *beau idéal* may be seen

[8] ''On the Elgin Marbles,'' *Works,* XVIII, 156. See also ''Flaxman's *Lectures on Sculpture, Works,* XVI, 353.

in "inferior" antiques, such as the Apollo and the Venus, but not in the Parthenon figures. Let Byron and the connoisseurs, who enjoy artifice and affectation, regard, if they wish, the Hercules as the personification of Strength, the Venus as the embodiment of Feminine Grace, and the Apollo as the type of the Beautiful Male! For his part he preferred the Elgin Marbles with their display of actual human beings engaged in incidents taken from real life. They were "human beings petrified . . . absolute facsimiles or casts from nature,"[9] not the idealized figures and composite beauties of the Hellenistic antiques.

Hazlitt, however, realized some of the difficulties in maintaining that the Elgin Marbles were "fac-similes" taken from nature, while his feeling that the men of his day had as "noble" forms as those of Antiquity caused him to modify the theory of a literal Imitation. Thus through a kind of compromise with the Ancients he came to accept a theory of selection. His final position seems, therefore, to have been that the Greek statues were neither the "middle forms" or abstractions of the Academies nor the composite beauties of Neo-Classical theories of art. Rather, they were "(*cum grano salis*) Grecian youths and nymphs"! Grecian youths and nymphs with a grain of salt is a quaint conception; but what Hazlitt meant was that the ancient artists had produced their great works by moulding into shape the materials of nature, neither doing violence to those materials nor forgetting the possible perfection in nature.

> Wherever the greatest individual genius has been exerted upon the finest models of nature, there the greatest works of art have been produced,—the Greek statues and the Italian pictures.[10]

Thus Michelangelo, Raphael, and the sculptors of the Elgin Marbles had been the greatest artists because they had impressed their genius upon nature. Argument ceases here, for Hazlitt now has little over which to argue with Sir Joshua and other more "classical" critics.

The fourth great merit of the Elgin Marbles, in the eyes of Hazlitt, was more general, namely, their ability to arouse visions of Antiquity. He shared the Renaissance delight in the very

[9] *Ibid.*, XVIII, 145, and XVI, 361.

[10] "On the Elgin Marbles," *Works*, XVIII, 157, and "Fine Arts. Whether they are Promoted by Academies and Public Institutions," *Works*, XVIII, 48.

"idea" of the classical world, in ancient works of art and in ruins evoking the pageantry of time.

> So the Elgin Marbles are more impressive from their mouldering, imperfect state. They transport us to the Parthenon, and old Greece. The Theseus is of the age of Theseus; while the Apollo Belvedere is a modern fine gentleman; and we think of this last figure only as an ornament to the room where it happens to be placed.[11]

The Greco-Roman statues were lifeless, boring, and trite; but the Parthenon sculptures carried Hazlitt away from those stuck-up, affected, and prettified gods and goddesses, too conscious of their perfection, back to an earlier, nobler, and simpler Greece. Over that land

> hovers a light, brighter than that of suns, softer than that which vernal skies shed on halcyon seas, the light that arises from the tomb of virtue, genius, liberty![12]

The true "noble simplicity" of the Antique—the Phidian marbles from the Parthenon—came, then, as sufficient rebuke to the abstractions of the classicistic artists like Flaxman, Canova, David, and Thorwaldsen. In his review of Flaxman's lectures at the Royal Academy Hazlitt pointedly stated the case of the "romantic" writers against the "academic" artists. In the works of Flaxman he perceived precision, balance, cool judgment, and an attachment to the best, while he failed to find richness, force, and variety. Cast in a classicistic mould, Flaxman's figures remained "elegant outlines—poetical abstractions converted into marble, yet still retaining the essential character of words."[13] A "romantic" critic, Hazlitt missed the vitality and "pathos"—the "interesting" qualities, the elements with which he could "sympathize"—of great sculpture like that from the Parthenon.

Hazlitt's dislike of what passed for "the Antique" sprang in large measure, too, from the fact that the world of fashion had adopted it; for the art of the Greeks and Romans, he felt, had become not only a prop for the Academies but also a plaything for the connoisseurs and dilettanti. Every gentleman had Greco-

[11] "The Marquis of Stafford's Gallery," *The Picture Galleries of England*, *Works*, X, 28.

[12] "Williams' Views in Greece," *Works*, XVIII, 171 ff.

[13] *Works*, XVI, 339 ff.

Roman statues (or parts of them), coins, intaglios, *et al.*, among his bric-a-brac. Hazlitt reported with a sneer that artists, raving of the glories of the Antique, proceeded to furnish "designs for the lids of snuff-boxes and ladies' fans."[14] How were the mighty masterpieces of the Greeks fallen!

The Elgin Marbles brought a breeze from a new and older and simpler Grecian world, revealing to the Romantic writers that the Greco-Roman statues had been the ancient "academic" art. Hazlitt, like Haydon, was hopeful that the Parthenon sculpture would blow away the cant of the Academies, the tawdry *virtù* of the connoisseurs, and the affected mode of dressing *à l'antique*.

III

Hazlitt not only recorded his impressions of the Elgin Marbles and the more famous Greco-Roman antiques but also made considerable use of ideas drawn from the study of sculpture and specific statues in writings on other subjects than the plastic arts. Statuary, especially that of the Greeks, appears in his literary and dramatic criticism and in his comments on plays and players with a frequency which indicates both his fondness for the fine arts and the widespread interest in the Antique at the time. His acquaintance with the art of sculpture surpassed that of any other Romantic critic; only Ruskin, Pater, and Symonds later in the century showed a greater knowledge of statuary.

One of the chief arbiters of taste in England between 1815 and 1830, Hazlitt showed some familiarity, of course, with the theories spread by the German Romantic writers and critics. Indeed, he seldom revealed his "romantic" tendencies as unmistakably as he did in reviewing John Black's translation (1815) of August Wilhelm Schlegel's *Lectures on Dramatic Literature* for the *Edinburgh Review*, since the ideas of the German critic helped to crystallize his own thoughts. Hazlitt seized upon Schlegel's antithesis between the "classical" and "romantic" spirits as "the *nucleus* of the prevailing system of German criticism" and the "foundation of his whole work." He found what readers almost invariably discover in such discussions, namely, "a singular mixture of learning, acuteness, and mysticism." The following distinction between "classical" and "romantic" gave, he felt, the

[14] "Fine Arts. Whether they are Promoted by Academies and Public Institutions," *Works*, XVIII, 38.

"clue out of the labyrinth" of Schlegel's characteristically German speculations:

> The most obvious distinction between the two styles, the classical and the romantic, is, that the one is conversant with objects that are grand or beautiful in themselves, or in consequence of obvious and universal associations; the other, with those that are interesting only by the force of circumstances and imagination.[15]

In short, the "classical" or ancient style "dwells more on the immediate impressions of objects on the senses." It is "the poetry of form"—objective poetry. The "romantic" or modern style, on the other hand, "dwells more on the ideas which [objects] suggest to the imagination." It is "the poetry of effect"—subjective poetry, or, as Hazlitt more frequently described it, poetry with "*gusto* or expression." The "classical" style gives the appearances of objects, while the "romantic" style reveals their soul, their essential spirit or "meaning."

Since the antique or "classical" style was characterized by a feeling for external appearance or form, the sculpture of ancient Greece served to illuminate the antithesis advanced by the German critics. Like Coleridge and De Quincey, Hazlitt borrowed Schlegel's analogy to the arts.

> As, according to our author, the poetry of the Greeks is the same as their sculpture; so, he says, our own more nearly resembles painting,—where the artist can relieve and throw back his figures at pleasure,—use a greater

[15] "Schlegel on the Drama," *Works,* XVI, 61. Hazlitt's remarks were made particularly on Schlegel's opening lecture. Schlegel's antithesis stemmed from the theories of his brother Friedrich and of Schiller. Hazlitt's poetry of "form" versus poetry of "effect" was the equivalent of Friedrich Schlegel's contrast between "die schöne Poesie" and "die interessante Poesie." (See Lovejoy, "On the Meaning of 'Romantic' in Early German Romanticism," Part II, *MLN,* XXXII, 1917, 66 ff., and "Schiller and the Genesis of Romanticism," Part I, *MLN,* XXXV, 1920, 3.) Of the five distinctive interpretations of the "romantic" notion of a "striving after an infinite content," which Professor Lovejoy has sketched ("Schiller and the Genesis of Romanticism," Part II, *MLN,* XXXV, 1920, 141 ff.), the interpretation which Hazlitt, like Friedrich Schlegel, reflected was the ideal of an art which should express "the infinite variety and inexhaustible interestingness of 'life'—*i.e.,* of the aspects of nature and the phases of human experience, especially of inner experience." To quote Hazlitt's essay on "The Indian Jugglers" (*Works,* VIII, 82–83), "the more ethereal, evanescent, more refined and sublime part of art is the seeing nature through the medium of sentiment and passion, as each object is a symbol of the affections and a link in the chain of our endless being."

variety of contrasts,—and where light and shade, like the colours of fancy, are reflected on the different objects. The Muse of classical poetry should be represented as a beautiful naked figure: the Muse of modern poetry should be represented clothed, and with wings. The first has the advantage in point of form; the last in colour and motion.

Then the English critic summarized Schlegel's remarks on the influence of the physical organization, situation (climate), religion and manners of the Greeks upon their arts. Most interesting was his contrast between the religious spirit of the Pagan Greeks and that of the Christian Moderns.

The Pagan system reduced the Gods to the human form, and elevated the powers of inanimate nature to the same standard. Statues carved out of the finest marble, represented the objects of their religious worship in airy porticos, in solemn temples and consecrated groves. . . . All was subjected to the senses. The Christian religion, on the contrary, is essentially spiritual and abstract; it is 'the evidence of things unseen.' In the Heathen mythology, form is everywhere predominant; in the Christian, we find only unlimited, undefined power. The imagination alone 'broods over the immense abyss, and makes it pregnant.' . . . A mysterious awe surrounds the doctrines of the Christian faith: the Infinite is everywhere before us, whether we turn to reflect on what is revealed to us of the Divine nature or our own.[16]

Here and elsewhere Schlegel referred to Winckelmann: since the "classical" spirit was that of sculpture, one should study the Antique, and Winckelmann, of course, was the best tutor of the principles of ancient art. Hazlitt, however, omitted the references to the great classicist from the review, probably because he knew very little, if anything, of Winckelmann's epochal works. Nevertheless he could write that

our author is right in affirming, that the true way to understand the plays of Sophocles and Aeschylus, is to study them before the groupes of the Niobe or the Laocoon. . . . For it is certain, that there are exactly the same powers of mind displayed in the poetry of the Greeks as in their statues. Their poetry is exactly what their sculptors might have written. Both are exquisite imitations of nature; the one in marble, the other in words.

Throughout his review Hazlitt admirably captured the spirit of the German Romantic aestheticians as he followed his "clue"

[16] *Ibid.*, pp. 65–66.

to the difference between "classical" and "romantic." The ancient artists, poets and sculptors alike, excelled in giving the appearances of objects: they were masters of form. The modern poets, although inferior to the Ancients "in this direct and simple imitation of nature," possessed the compensating power of an imagination which "represents objects, not as they are, but as they are moulded according to our fancies and feelings."[17] The "classical" style was objective, material, sensual, sculptural. It was an imitation of objects grand and beautiful in themselves. The "romantic" style, however, was subjective, incorporeal, spiritual, picturesque (*i.e.*, with "dramatic" contrasts). Imagination presented the "effect" of objects—their "truth of feeling."

Thus, the great problem of every "romantic" or modern writer or artist became one of expression: through the force of his imagination or sympathetic insight he must reveal the significance of the circumstances of his own age. Hazlitt believed he could find that vitality, expressiveness, or significance through Sympathy. As Spiritual Vision was the core of Blake's theories of art, and the Esemplastic or Shaping Power of the unifying Imagination was the center of Coleridge's, so Sympathy constituted the keynote of Hazlitt's aesthetics.

IV

Hazlitt's description of plays and players in language borrowed from the "classical" art of sculpture gives his writing an interesting place in the history of theatrical criticism in England. On many occasions he showed that the custom, begun by critics as different in temperament as Edward Young and Goldsmith, was becoming widespread, now that De Quincey, Hunt, Keats, and Hazlitt went to the theatre with heads full of the Antique. Spectators liked to be reminded of classical art; readers of reviews of plays understood and admired a description of acting by reference to sculpture; and gentlemen expected, even demanded perhaps, allusions to antiques in criticism as well as in costume and in poetry, in household furnishings and in novels.

[17] *Ibid.*, pp. 62–63. "The ideas of the ancients were too exact and definite, too much attached to the material form or vehicle in which they were conveyed, to admit of those rapid combinations, those unrestrained flights of fancy, which, glancing from heaven to earth, unite the most opposite extremes, and draw the happiest illustrations from things the most remote. The two principles of imitation and imagination indeed, are not only distinct, but almost opposite."

Hazlitt made most use of sculpture in writing of players and the art of acting; from his work one learns how often the man of culture and sentiment relied then upon the Antique. Mrs. Siddons, whom Reynolds had set the fashion of regarding as "The Tragic Muse," he considered "like a cast from the antique, or rather like the original, divine or more than human, from which it was taken."[18] A typical description sketched a Miss O'Neill with Grecian features possessing "that mixture of beauty and passion which we admire so much in some of the antique statues." Accordingly, she was qualified to act in "the stately, elegant, and simple drama of the Greeks":

> Her style of acting was smooth, round, polished, and classical, like a marble statue; self-supported, and self-involved; owing its resemblances to life, to the truth of imitation; not to startling movements, and restless contortions, but returning continually within the softened line of beauty and nature.[19]

Above all, Hazlitt never tired of contrasting the "statue-like" acting of J. P. Kemble, the "classical" actor, with the variety and expressiveness of the "romantic" Kean—to the advantage, of course, of the latter. Kemble suggested an Apollo or an Antinous:

> It has been said of the Venus de Medicis, 'So stands the statue that enchants the world'; the same might have been said of Mr. Kemble. He is the very still-life and statuary of the stage; a perfect figure of a man; a petrifaction of sentiment, that heaves no sigh, and sheds no tear; an icicle upon the bust of Tragedy.[20]

In contrast to this "classical" icicle on the bust of Tragedy, Kean was like leaping flames or flashes of lightning. Hazlitt preferred Kean's activity and passion and expressiveness to Kemble's frigid statue. Even as he responded to the vitality and "naturalness" of the Elgin Marbles rather than to the lifeless and elegant Apollo and Venus, so his sympathy went to the "picturesque" or "romantic" Kean rather than to the "statuesque" or "classical" Kemble.

A similar feeling appeared in the critic's remarks about Addison's *Cato* (1713), the English play most often described in terms derived from the art of sculpture during the eighteenth century.

[18] "Mrs. Siddons," *Works*, XVIII, 407.

[19] "The Drama: No. II," *Works*, XVIII, 283–84.

[20] "Mr. Kemble's Cato," *Works*, V, 342, and "Mr. Kemble's Sir Giles Overreach," *A View of the English Stage, ibid.*, p. 304.

Though Edward Young considered the play a drama of the closet unsuited to the stage, he had genuinely admired its sculpturesque qualities. Some sixty years later Hazlitt criticized *Cato* in approximately the same terms: it was "a marble slab," an ancient bas-relief. But he looked at the play with less admiring eyes than Young's, and he regarded *Cato* as a drama in name only.[21]

In his non-dramatic criticism Hazlitt followed the fashion of Jonathan Richardson, Senior, Horace Walpole, and James Barry —to name but a few of the critics of the eighteenth century who had linked together Milton and the "Grecian Gusto"—by associating the poetry of Milton with sculpture. Contradicting Coleridge for asserting that the poet's ideas and images were "musical" (*i.e.*, not to be associated with definite objects), Hazlitt maintained that they were often also "picturesque" (*i.e.*, clearly visualized).

> The strongest and best proof of this [feeling for the definite object], as a characteristic power of his mind, is, that the persons of Adam and Eve, of Satan, etc., are always accompanied, in our imagination, with the grandeur of the naked figure; they convey to us the ideas of sculpture.[22]

Of Milton's description of Satan's meeting with Uriel (*Paradise Lost*, III. 621 ff.) Hazlitt remarked, "The figures here have all the elegance and precision of a Greek statue." He also mentioned the figure of Beelzebub as another sculptural figure; for that fallen angel

> With Atlantean shoulders fit to bear
> The weight of mightiest monarchies

has suggested an ancient statue of Atlas or Hercules to many readers.[23] His comments seem to have been due, in part, to his discussions concerning the heroic art of Milton and the Elgin Marbles, first with Haydon and then with Keats, who was studying the art of "stationing" his sculptural figures in the manner of Milton and the Greek artists.

In the poetry of Chaucer, whom Hazlitt termed the poet of

[21] See Young's *Conjectures on Original Composition* [1759], ed. Edith Morley (Manchester University Press, 1918), p. 40, and "Mr. Kemble's Retirement," *Works*, V, 379, and also VI, 356.

[22] "On Milton's Versification," *Works*, IV, 38 ff., Coleridge's *Table Talk*, August 7, 1832, and *Coleridge's Shakespearean Criticism*, ed. Thomas M. Raysor (Harvard University Press, 1930), II, 138–39.

[23] *Ibid.*, and *Lectures on the English Poets*, V, 61.

"downright reality," he likewise found a definiteness akin to that of sculpture. Besides observing that the poet "exhibits for the most part the naked object, with little drapery thrown over it," he felt that Chaucer's "descriptions have a sort of tangible character belonging to them, and produce the effect of sculpture on the mind." The sculptural quality which Hazlitt had in mind in using the term "tangible character" was derived from his view of the Greco-Roman statues, which he regarded as the expression of one abstract or typical trait. Similarly, Chaucer's pilgrims possessed "tangible character": "they are every one samples of a kind." Moreover, for his interpretation of the Chaucerian figures, Hazlitt was indebted to William Blake, who had mentioned Greco-Roman sculpture several times in his *Descriptive Sketches* in characterizing the Canterbury pilgrims. Thinking of such a statue as the Venus—the expression of one "characteristic," one moral or physical quality, according to the eighteenth-century theorists—Blake described each pilgrim as "an Antique statue, the image of a class and not an imperfect individual." Since Blake's criticism fell in with Hazlitt's own view of the Grecian statues other than the Elgin Marbles, he wrote of the typical, abstract, and "tangible" sculptural pilgrims.[24]

Still, Hazlitt was unwilling to think of Chaucer, with his unlimited knowledge of human nature, as an "abstracter" of the sort admired by his Academic foes. Therefore, he showed his "romantic" colors when he added, in the spirit of Coleridge and the German Romantic critics, that those sculpturesque descriptions of external appearances in the Prologue to the *Canterbury Tales* were actually "symbols of internal sentiment." Like the best Greek statues, the sculptures from the Parthenon, the figures of Chaucer were neither cold nor abstract forms. On the contrary, they were very much alive—expressive, natural, dramatic. Since he had been a great poet, Chaucer must have charged his simple and sculptural conceptions with the pathos and the vitality demanded by "romantic" writers like himself. Apparently Hazlitt

[24] "On Chaucer and Spenser," *Lectures on the English Poets, Works,* V, 20 ff. See also *Poetry and Prose of William Blake,* ed. Geoffrey Keynes (Nonesuch-Random House 1-volume ed., 1935), pp. 974–75. Hazlitt failed to mention Blake by name, and it is very likely that he had heard these statements expressed or read to him by Charles Lamb, who considered Blake's remarks the finest criticism of Chaucer he had ever read: see *The Works of Charles and Mary Lamb,* ed. E. V. Lucas (London, 1903), VII, 643.

believed that the Grecian sculptors had worked according to the principles followed by many writers of the Romantic period. It is no wonder, then, that the Elgin Marbles frequently served in his works as perhaps the noblest illustration of his own theories about art and aesthetic activity.

When a contemporary poet wrote in a sculptural style, Hazlitt gave him similar praise. After calling Wordsworth's *Laodamia* an "exquisite poem," he continued,

> [It] breathes the pure spirit of the finest fragments of antiquity—the sweetness, the gravity, the strength, the beauty and the languor of death—'Calm contemplation and majestic pains.' Its glossy brilliancy arises from the perfection of the finishing, like that of careful sculpture, not from gaudy colouring—the texture of the thoughts has the smoothness and solidity of marble. It is a poem that might be read aloud in Elysium, and the spirits of departed heroes and sages would gather round to listen to it![25]

On another occasion he singled out for exceptional praise the line, "Elysian beauty, melancholy grace," and said, "I would as soon have written that line as have carved a Greek statue." Such encomium more than compensated for his notorious caricature of the Lake Poets in the *Lectures on the English Poets.* Without Hazlitt's study of Greek sculpture, and especially the Elgin Marbles, these comments on Wordsworth would have been entirely different. Moreover, they present a fine example of the use in literary criticism of ideas derived from sculpture, ideas of a kind which were to become increasingly common in English criticism in the later nineteenth century.

V

Finally, as one of the many Englishmen of the nineteenth century who struggled to find intellectual and spiritual bases which satisfied them, Hazlitt came to be interested, like Coleridge and Wordsworth, in the relationship between the religious beliefs and the arts of the Greeks. In their concern with questions of belief, the three Romantic writers pointed out one of the major problems in the thinking of the later nineteenth century, which culminated in England in Matthew Arnold's discussions of Hellenism and Hebraism.

[25] "Mr. Wordsworth," *The Spirit of the Age, Works,* XI, 90. See also "Landor's *Imaginary Conversations*," *Works,* XVI, 253.

Because he was a thoroughgoing "romantic," Hazlitt maintained that a vital faith fosters the arts as no Academies can, stating his opinion in terms similar to those which Mr. T. S. Eliot has recently made very familiar. Possibly even the late Irving Babbitt would not have objected to Hazlitt's remarks about the relation of tradition to individual talents:

> Perhaps the only patronage which was ever really useful to the arts, or worthy of them, was that which they received first in Greece, and afterwards in Italy, from the religious institutions of the country; when the artist felt himself, as it were, a servant at the altar; when his hand gave a visible form to Gods or Heroes, Angels or Apostles; and when the enthusiasm of genius was exalted by mingling with the flame of national devotion. . . . He had to embody, by the highest efforts of his art, subjects which were sacred to the imagination and feelings of the spectators; there was a common link, a mutual sympathy between them in their common faith.[26]

Again and again Hazlitt asserted that the genius of the individual must "cooperate" with the mind of the age or country in order to produce truly significant works. Inheriting a preference for things classical, yet determined to find subject-matter and means of presentation appropriate to their age, the Romantic poets and critics felt that it became increasingly difficult to "cooperate" with the Ancients, because they had been silent about many emotions and experiences familiar to men in the nineteenth century. Speaking as every Romantic writer at some time expressed himself, Hazlitt cried, "What modern can enter fully into the spirit of the ancient Greek mythology, or rival the symmetry of its naked forms?"[27]

Romantic poets and critics, none the less, continued to look to the past, but not as the gentlemen of the eighteenth century had turned to Antiquity; as may be seen in their different conceptions of the Renaissance, their nearest link to the classical world. The Augustans had regarded the Revival of Learning as the rediscovery of the perfect taste by which the eighteenth century became urbane, reasonable, and enlightened. In short, they refined themselves in the light of Antiquity. Hazlitt, however, saw the Renaissance as the Rebirth or Renewal of the miracle of creative activity.

[26] "Fine Arts. Whether they are Promoted by Academies and Public Institutions," *Works,* XVIII, 44.

[27] "English Students at Rome," *Works,* XVII, 139.

It had been bliss to be alive when a new world came into being! Like Shelley, he also imagined the early Renaissance poets as having felt themselves links new-forged in the golden chain of poets who hailed the glories of the antique world as examples for their own endeavors. Similarly, gifted with imagination, the English Romantic writers were to emulate the Greek poets and sculptors in creating art out of the circumstances of their own age.

This obligation fell in particular upon the poets, since they felt that the nature of their medium—language with its seemingly endless ways of communicating and suggesting the sensations, emotions, and thoughts of human beings—gives them the lead in the race for expressiveness. In his lecture "On Poetry in General" Hazlitt took his stand with the poets who have proclaimed their craft the most expressive of the arts. Reviving this time-honored argument, Hazlitt asserted again that the great supremacy of poetry over the other arts rests in its ability to depict both movement and the progression of events, whereas the painter or sculptor is limited to the presentation of *one* happening. In showing the one attitude, one group, or one moment the sculptor excels, to be sure, but he is therefore at a disadvantage in the race for expressiveness. Form is the province of the sculptor, said Hazlitt, but the shapes he creates will amount to little if they are merely polished, learned, and correct, like the "Grecian" Outlines employed by the classicistic artists.

A "romantic" writer, Hazlitt insisted that the works of poet and artist must achieve significance above all by expressing the spirit of the age. An artist or poet could best gain that significance by a sympathetic insight into nature and mankind, or, in other words, by regarding with imaginative delight the "pathos" and activity of the life about him.

Waterville, Maine

THE HISTORIAN'S APPROACH TO PSYCHOLOGY*

By Sidney Ratner

As the historian pursues his quest for the recapture of past time, he cannot refrain from suggesting some explanation of those processes in man's consciousness of himself, his fellow men and the world he lives in, which we call the course of history.[1] Wittingly or not, historians feel impelled, as Justice Holmes phrased it, to make plainer the way from one thing to the whole of things, to show the rational connection between seemingly isolated facts and other facts—within man's own constitution and outside it.[2] Yet in their expositions of the forces patterning man's history, historians have made little attempt to utilize the insights, the principles, or the techniques offered by the psychologists.

The failure of the historians to make such a synthesis between psychology and history may be due in part to the fact that "psychology has had a long past, but a short history."[3] Modern scientific psychology is a comparatively young discipline and has not until recently won enough prestige to make historians acquire a guilt-complex about not being fully initiated into its mysteries. They also have been influenced by the law of inertia in keeping to the traditional path of historical research and in letting others undergo the trials of pioneers in subduing new territory. As Bertrand Russell once said, so long as a man remains a critic of the theories of others, he is invincible, but as soon as he advances a theory of his own, he lays himself open to refutation.[4] It requires a will to learn as powerful as their will to teach for specialists to start learning new subjects and correlating the new material with the old they are already accustomed to.

* This paper was presented in a modified form before the American Historical Association in Washington, D. C., on December 28, 1939.

[1] *Cf.* William James, *Principles of Psychology* (New York, 1890), I, 224–290, and Marcel Proust, *Le Temps retrouvé* (Paris, 1927), II, 237–261.

[2] Oliver Wendell Holmes, *Collected Legal Papers* (New York, 1921), p. 29.

[3] This remark of Ebbinghaus, a noted German psychologist, is cited in Edwin G. Boring, *A History of Experimental Psychology* (New York, 1939), VII.

[4] Bertrand Russell, *Principles of Mathematics* (Cambridge, 1903), 469.

Moreover, they have had the excuse that until the end of the nineteenth century the great majority of scientific psychologists, especially in America, immersed themselves in the microscopic study of sensation, memory, habit formation, and intellectual processes, with little concern for the problems of human motivation in which the social sciences were most keenly interested.[5] Psychology, as Horace M. Kallen has put it, seemed to be a technique by means of which psychologists ignored human nature. In more recent years the fierce controversies that have raged over the relative merits of behaviorism, psycho-analysis, organicism, Gestalt psychology, and other psychological systems made many historians unsure as to what psychological tools and concepts were sound and could be used safely in their work.[6] They usually decided to avoid any risks by relying on a "common-sense" psychology and on whatever insights or hunches they had of their own or had absorbed from the cultural milieu, especially through such literary influences as Flaubert, Tolstoy, Zola, Dreiser, and Sinclair Lewis. A few daring spirits like James Harvey Robinson and Lytton Strachey aroused the admiration of some and the criticism of many for their courageous use of new ideas propounded by the frontier-thinkers in psychology.

Unfortunately, a theory is not the sounder for being held uncritically. The teachings of common-sense on race, instinct, the inflexibility of human nature, sex differences, intelligence, and other matters are all too often ingrained prejudice and obsolete psychological doctrine.[7] That is why critical historians like Karl Lamprecht, who defined history as applied social psychology, have felt so keenly the need for more fruitful collaboration between the two disciplines and have called for a "psychic mechanics" from the psychologists that would explain the nature and movement of

[5] Robert S. Woodworth, *Contemporary Schools of Psychology* (New York, 1931), 185.

[6] *Cf.* Edna Heidbreder, *Seven Psychologies* (New York, 1933); Carl Murchison, ed., *Psychologies of 1930* (Worcester, 1930); R. S. Woodworth, *op. cit., passim.*

[7] Morris R. Cohen, *Reason and Nature* (New York, 1931), 76 ff., 293 ff.; John Dewey, *Human Nature and Conduct* (New York, 1930), *passim.* See Merle Curti, *Social Ideas of American Educators* (New York, 1935), 396–498, on the difficulties and obstacles even scientific psychologists face in trying to emancipate themselves from wide-spread biases.

historic forces.[8] Such a mechanics is still not to be had in any definitive, architectonic form. But the last thirty to forty years have seen a body of solid work emerge in individual and social psychology within the context of anthropology, economics, political science, and sociology, that is relevant to the needs of historians. This can be used as the basis for developing a science of psychology that will not be limited to the laboratory or to the locale of recent and contemporary Western society, but will endeavor to gain insight into all the periods, areas, and phases of man's manifold activities on this planet from Peking- and Java-Man down to the *homo infelix* of today.[9]

The recent advances that the use of psychology has made possible in psychosomatic medicine and in legal reform and science encourage the historian to disregard his fears about the unsuitability of his material for such new approaches.[10] The new interests of historians often lead them to discover new materials that answer questions on which the old material could shed no light. Even when the desired discoveries are not forthcoming, historians, by re-examining the old material in the light of their new hypotheses or guiding principles, can usually discover new implications, facts, and facets that illuminate the new problems they are concerned with.[11]

The concept in psychology that seems to me to lead to the greatest number of insights for the historian is that of the relative plasticity and flexibility of human nature. Men are not born as human

[8] Gardiner Murphy, *Historical Introduction to Modern Psychology* (New York, 1929), 418, 446. The supplement by Heinrich Kluver, "Contemporary German Psychology," *op. cit.*, 417–455 is a valuable addition to an able and very useful book.

[9] The key articles in the *Encyclopaedia of the Social Sciences* on psychology, psycho-analysis, social psychology, and the other social sciences indicate a wealth of material to be exploited and synthesized. See also William F. Ogburn and A. Goldenweiser, ed., *The Social Sciences* (Boston, 1927).

[10] Franz Alexander, *The Medical Value of Psychoanalysis* (New York, 1932); H. Flanders Dunbar, *Emotions and Bodily Changes* (New York, 1939, 2nd ed.), 3–110, 427–432; Edward S. Robinson, *Law and the Lawyers* (New York, 1935), 72–166.

[11] *Cf.* Charles A. Beard, *The Discussion of Human Affairs*; *passim.*; John Dewey, *Logic* (New York, 1938), 220–244, 487–512; Allan Nevins, *The Gateway to History* (New York, 1938), 49–237; James T. Shotwell, *Introduction to the History of History* (New York, 1922), *passim.*

beings in the full cultural sense of that term, with fixed, "inalienable" instincts that determine inevitably the whole course of their development. They are born as "raw" biologic organisms, with certain basic needs and drives, such as those for food, shelter, and sex. But humanity, the set of qualities that we associate with human beings, is an acquisition and an achievement by these organisms made possible by the society into which they are born and whose culture they make part of themselves.[12]

Men have acquired the minds and the selves they possess through interaction with other men and with the world of nature.[13] Prehistoric man created the beginnings of the distinctively human mind and personality by evolving, through gestures and sounds, significant symbols. This use of symbols for expressing and communicating experience became the basis for forming communities, and one prime distinction between human beings and the rest of the animal kingdom. Language, however, though very important, has been and is only one of the many influences that mould the biologic organism, called by courtesy at birth a member of the species *homo sapiens,* into a bio-cultural being worthy of the name human being.[14]

From the Java- and Cro-Magnon Man to the civilized man of today, men have evolved numerous types of society. Each of these societies—whether it be ancient Egypt, medieval Europe, Japan under the Tokugawas, or America in mid-passage towards an un-

[12] Ruth Benedict, *Patterns of Culture* (Boston, 1934); John Dewey, *Human Nature and Conduct*; John Dollard, *Criteria for the Life History* (New Haven, 1935); Lawrence K. Frank, "Projective Methods for the Study of Personality," *Journal of Psychology* (Oct., 1939) 8: 389–413; Karen Horney, *The Neurotic Personality of Our Time* (New York, 1937); Margaret Mead, *Sex and Temperament* (New York, 1935); James S. Plant, *Personality and the Cultural Pattern* (New York, 1937); Muzafer Sherif, *The Psychology of Social Norms* (New York, 1936). Also, *cf.* Arthur F. Bentley, "Situational vs. Psychological Themes of Behavior," *Journal of Philosophy* (March 30, June 8, July 20, 1938) 36: 169–81, 309–23, 405–13.

[13] Each organism has its own pattern of sensitivity and initiative and hence selects in part the stimuli to which it responds. It also helps to change and to construct the environment in which it lives, as our cities and machine civilization bear witness, both on the social and technological side.

[14] George H. Mead, *Mind, Self, and Society* (Chicago, 1934) is a brilliant study of this theme. See also the symposia on personality development, the relation of the individual to the group, and the influence of Freud in the *American Journal of Sociology* for May, 1937, May, 1939, and November, 1939; v. 42, no. 6, v. 44, no. 6, and v. 45, no. 3, respectively.

known destiny—has selected only one arc of the great circle of possible human behavior for elaboration. Each has instilled certain emotions and attitudes towards specific acts, objects, and situations in its members. Each has inculcated certain folkways, *mores,* as the socially approved norms or patterns of behavior. Each has sought to impress its world-outlook and scale of values on its members.

For the historian this emergence, crystallization, and transformation of human minds and personality-patterns under varied social and natural environments is a process that is fascinating to contemplate aesthetically, and crucially important to analyze scientifically. The different ways men feel, think, and act in these societies are socially acquired and developed, not biologically inherited, traits. A biologic basis exists, of course, in the structure and sensitivity of the human organism, but the extent to which, the means by which, and the ways in which the various human drives will be satisfied vary tremendously from society to society.

The scientific historian, then, is confronted with the necessity of extending his critical acumen from the weighing of evidence concerning what events occurred in specific times and places to inquiring why they happened as they did and what psychological mechanisms they involved. He cannot assume a bellicose instinct to account for war, an acquisitive instinct for private property, an instinct of awe for religion, an instinct of workmanship for craftmanship, and as many other instincts as there are human traits or institutions to explain. Nor can he assume a neat mechanical system of fixed atomic emotions and sentiments that go through definite combinations, as Pareto's ballet of bloodless categories does.

His task is rather to analyze the specific social patterns in the society his attention is focused on, and to discover how habits, emotions, and values have been developed in the individuals of that society so that they have learned to respond in predictable ways to definite stimulus-situations which would have evoked different responses from individuals who had a different social conditioning, *e.g.,* Mahatma Gandhi and Hitler. This involves seeing the configuration of the society as a whole, the interplay of different institutions, the forces affecting the whole life-span development of individuals from birth to death. It also involves seeing that, though habit is "the enormous fly-wheel" of society and its most conservative agent, old habits (and institutions) can and do give place to

new as individuals are affected by and learn to respond successfully to new situations.[15] The changes in all phases of Western civilization by the developments of modern science and technology are the most spectacular illustrations of this fact.

Every society known to the historian has or has had its distinctive hierarchy of values, its special set of goals or levels of aspiration which its members have desired to achieve. The nature of these goals has varied from society to society, and within a society from one age, sex, and class group to another.[16] The attainment of these goals either has been facilitated through such social mechanisms as the economic, educational, and political systems, notably in the United States prior to 1929, and in the Scandinavian democracies prior to April, 1940, or has been rendered difficult or impossible for all but a chosen few, as in the caste system of India. Sometimes one set of social mechanisms, such as the American educational system, may be building up certain goals that other social mechanisms, *e.g.*, private business enterprise, may be working against.[17]

If the frustrations in the society outweigh heavily the satisfactions for large numbers of intelligent, aggressive individuals, strong tensions are created for which these individuals seek release through some form of social change, be it reform or revolution. The American, French and Russian revolutions and the English reforms from 1832 to 1911 offer the classic case-studies here.[18] When the intelligence, courage, and ability to make the needed ad-

[15] William James, *Principles of Psychology,* I, 121 f.; Kurt Lewin, *A Dynamic Theory of Personality* (New York, 1935) and *Principles of Topological Psychology* (New York, 1936); Thorstein Veblen, *The Place of Science in Modern Civilization* (New York, 1919), 73–81, 241–251.

[16] *Cf.* Sidney Ratner, "Patterns of Culture in History," *Philosophy of Science* (Jan., 1939) 6: 88–97.

[17] Ruth Benedict, "Anthropology and the Abnormal," *Journal of General Psychology* (Jan., 1934) 10: 59–82; "Some Comparative Data on Culture and Personality with Reference to the Promotion of Mental Health," *American Association for the Advancement of Science Publication No. 9,* 245–249.

[18] *Cf.* Lawrence K. Frank, "Management of Tensions," *American Journal of Sociology* (March, 1928) 33: 705–736; "Society as the Patient," *op. cit.* (Nov., 1936) 42: 335–44. See also Crane Brinton, *The Anatomy of Revolution* (New York, 1938), a clever but circumscribed volume; and for contrasting approaches, J. F. Brown, *Psychology and the Social Order* (New York, 1936) and L. P. Edwards, *The Natural History of Revolution* (Chicago, 1927).

justments are lacking, the society either stagnates, collapses, or goes into eventual decline and disintegration. Examples from ancient Egyptian, Chinese, Greek, and Roman history occur at once to every scholar.[19] Other examples from current history need not be cited.

The penalty for ignorance of the past, as Santayana has put it, is that one repeats the errors of the past when they might have been avoided.[20] The penalty for great knowledge of the past is that one often slights the significance of past events as experiments in living. Because one is intensely absorbed in the drama of the past as it actually unfolded, one is tempted to ignore the possibilities of what might have happened, had alternative courses of action been taken. Here the analytical tools of a psychology based on the comparative methods of anthropology prove their value to history as weapons against provincialism and dogmatism and as aids to a critical evaluation of the social mechanisms that have either enriched or impoverished human life.

The unsuspected alternatives to the seemingly fixed traits of human behavior were, perhaps, first dramatically brought to most people's attention by William James's essay on "The Moral Equivalent of War."[21] This shocked many as deeply as Darwin's *Origin of Species* had their parents.[22] The intellectual climate of opinion in which they lived precluded their perceiving substitutes or equivalents for the institutions and folkways they had been conditioned

[19] Arnold J. Toynbee devotes Volumes IV to VI of his *Study of History* to the most extended study yet made of the causes for the decay of all those historic civilizations that have declined or perished. The escapes which war and fascism seem to offer from internal adjustment for the general welfare of the peoples involved, are subjects that I can not treat in detail here. Interesting psychological studies are to be found in Max Ascoli and Arthur Feiler, *Fascism for Whom?* (New York, 1938); Peter F. Drucker, *The End of Economic Man* (New York, 1939); Hermann Rauschning, *The Revolution of Nihilism* (New York, 1939); Ignazio Silone, *The School for Dictators* (New York, 1938). *Cf.* G. A. Borgese, *Goliath: The Mind of Fascism* (1937) and G. Salvemini, *Under the Axe of Fascism* (1936).

[20] George Santayana, *Interpretations of Poetry and Religion* (New York, 1924), 170.

[21] William James, *Memories and Studies* (New York, 1911), 267–296. See Horace M. Kallen, "Of War and Peace," *Social Research* (Sept., 1939) 6: 361–391, for a challenging re-interpretation of the whole problem.

[22] *Cf.* Sidney Ratner, "Evolution and the Rise of the Scientific Spirit in America," *Philosophy of Science* (Jan., 1936) 3: 104–122.

to regard as universally indispensable, such as war, a competitive economy, the patriarchal family. The future advance of history, however, I venture to assert, will be judged in part by the extent to which it can assimilate and apply the anthropological approach and the logic of James's analysis as developed by John Dewey in *Human Nature and Conduct.*

Perhaps the points I wish to make can be best clarified by considering the three historians who have influenced American historiography most in the past fifty years: Frederick Jackson Turner, Charles A. Beard and Vernon Louis Parrington. Each has been a major intellectual force, yet each has also been a storm-center of sharp controversy which I believe could have been averted in part, if their psychological theories and assumptions had been more clearly stated and adequately developed.

Turner asserted in his celebrated essay on "The Significance of the Frontier in American History" that the main determining factor in the development of the American people and civilization down to 1890 was the influence of the ever-retreating frontier, with its area of free land drawing settlers ever westward.[23] To this influence he ascribed the rise of American democracy and nationalism and the formation of those temperamental qualities deemed essentially American: individualism, practicality, inventiveness, the masterful grasp of material things, coarse strength, restless energy, and a buoyant, exuberant spirit. In reacting against the excessive attention paid to the Germanic origins of American society, he seems to have swung into a counter-overemphasis of his own and to have implied that all human beings, certainly all Europeans, whatever their past cultural conditioning, who came as colonists to America, would be mastered by the wilderness and be transformed into the American type he knew and cherished.

Actually the American character as delineated by Turner in this and other essays was not created by the impact of the frontier on biological organisms unmoulded by a complex culture. The interaction in the beginning of our history was between the frontier

[23] Frederick Jackson Turner, *The Significance of the Frontier in American History* (New York, 1920), 1–38, presents the version of the essay usually referred to. The original 1893 version is reprinted in *The Early Writings of Frederick Jackson Turner* (Madison, 1938), 183–229; the various emendations Turner made are noted in an appendix, *op. cit.*, 273–291. An essay by Fulmer Mood, "Turner's Formative Period," 3–39, traces in detail the development of Turner's life and thought down to 1893 and the sources of inspiration for his conception.

and the emigrant from the British Isles (in the main), whose personality-pattern had been given its special set by the British cultural pattern of the seventeenth and eighteenth centuries. The British social system and heritage had so conditioned and predisposed those who emigrated to America that under the emancipating conditions of the frontier they could develop the qualities and habits now felt to be distinctively American.[24]

But similar frontier conditions led people conditioned by the other types of cultures into which they were born to develop temperaments and values different from those of our American tradition. The French settlers in Canada, the Spaniards in Latin America, the Greeks from the ancient city-states who established settlements from the Black Sea to Spain, the empire-building Romans, Arabs, Tartars, Chinese and Japanese—all were pioneers, yet none developed all the qualities Turner attributed to the influence of the frontier *per se*. The pioneer communities in New Zealand and Australia, to the extent that they developed traits similar to the American, demonstrate that the British cultural pattern was as important a factor as the frontier in the transformation of character and transvaluation of values the original British settlers underwent in this new environment.

These considerations do not nullify the importance of this contribution by Turner to our understanding of American history. They indicate rather the need for the careful qualification of even the most penetrating insight by the explicit introduction of the cultural factor into the historical equation: frontier + pioneer = American. A scrupulous study of all of Turner's writings, especially his last book, *The United States, 1830–1850,* enables one to interpret the text of his most noted essay in the light of his keen awareness of the existence and importance of other factors than the frontier and of his painstaking effort to do justice to the complexity and multiplicity of historic forces and processes.[25] That awareness, however, was not sufficient to counterbalance for the general public, and for most historians, his failure in the most widely read of his essays to work out in some detail the social and

[24] *Cf.* James G. Leyburn, *Frontier Folkways* (New Haven, 1935); A. J. Toynbee, *A Study of History* (2nd ed. 1935), I, 465–7.

[25] Especially noteworthy are the very penetrating theoretical analyses in his *Significance of Sections in American History* (New York, 1932), 3–51, 183–206, 287–339.

psychological factors that made the American pioneers respond as they did to the challenge of the frontier.

Turner was correct in stating that the frontier acted as a crucible in forming a composite nationality out of the English, Irish-Scotch and Palatine German settlers in the colonial period,[26] but wrong in omitting to indicate that the success of the experiment was due to special factors in the cultural, as distinguished from the racial, background of the early settlers that aided, instead of blocking, the fusion. He had the genius to see that the frontier created a strong *tendency* in human beings to act in certain ways. By failing to stress with equal dramatic effect the possible counteracting influences in the cultural background of settlers, however, he created the impression that the *universal* effect and operation of the frontier was as he described it for one limited area and period in world history. That error must be corrected if we are to build on Turner's genuine insights sound evaluations of the processes of civilization he studied with such care, originality, and illumination.[27]

Charles Beard's *An Economic Interpretation of the Constitution, Economic Origins of Jeffersonian Democracy,* and *The Rise of American Civilization* (in collaboration with Mary R. Beard) have made him the leading exponent of the economic interpretation of American history as well as the leading American historian of our day. The breadth, sweep, and brilliancy of Beard's work compel everyone's admiration. All of us are indebted beyond measure to his path-breaking and monumental achievements, as well as to the inspiration of his moral courage and intellectual integrity. Yet he has incurred stringent criticism for the stress he has laid on the crucial importance of economic interests in the determination of men's beliefs and actions. Some of this criticism can be

[26] Turner, *Early Writings,* 211–12; *Significance of the Frontier,* 22–23.

[27] For other critical appraisals and points of view on Turner, see Charles A. Beard, "The Frontier in American History," *New Republic* (Feb. 1, 1939) 97: 359–62; Carl Becker, *Everyman His Own Historian* (New York, 1935), 191–232; Merle E. Curti, "The Section and the Frontier" in Stuart A. Rice, ed., *Methods in Social Science* (Chicago, 1931) 353–67; Carter Goodrich and Sol Davison, "Wage-Earner in the Westward Movement," *Political Science Quarterly* (June, 1935) 50: 161–85, (Mar., 1936) 51: 61–116; Murray Kane, "Safety-Valve Doctrine of the Frontier," *Mississippi Valley Historical Review* (Sept., 1936) 23: 169–88; Fred A. Shannon, "Homestead Act and the Labor Surplus," *American Historical Review* (July, 1936), 41: 637–51.

dismissed as due to intellectual resistance to new points of view; some as wilfully malicious on the part of those who would not have the truth made known for fear of the consequences to vested interests. But much of the criticism was due to the fact that when Beard in 1913 published *An Economic Interpretation of the Constitution* he did not present, or intend to present, a complete view of all the drives, interests, and values of the Fathers of the Constitution, since his desire was to present the neglected phases of the subject.[28] Consequently, his analysis of and conclusions on the very high correlation between the property interests and the political views of these statesmen made him seem to be an economic mechanist.

Similarly, some fourteen years later, his emphasis in *The Rise of American Civilization* on the intimate connection between the economic system and other phases of society, and on the dominant rôle of class and sectional economic interests, although it won many to complete acceptance of that view, made others rebel against what seemed a too highly schematized interpretation of American life and a too heavily weighted "materialistic" bias. Here again one may say that a large number of such reactions was due either to uncritical reading or to misinterpretation of the *Strukturzusammenhang,* the inner unity, of the book. The art of reading is difficult, since we usually read to confirm our prejudices rather than to eliminate them.[29] Charles Beard's incisive preface to his and Mary R. Beard's *magnum opus* should have convinced all readers that the Beards were attempting a synthesis of all the elements in American civilization, with due justice to their interplay and interpenetration.

Nevertheless, a sympathetic reader of *The Rise of American Civilization* must acknowledge that the Beards' text offers occasions, as well as pretexts, for misinterpretation and criticism. Although Beard indicates and describes in detail the importance of non-economic motives, values, and institutions, he lays such em-

[28] See Charles Beard's new introduction to *An Economic Interpretation of the Constitution* (New York, 1935), V–XVII. No full-length study of Beard has been done as yet, but consult Herbert Herring, "Free Lance among the Historians," *Harper's* (May, 1939), 178: 641–652; and Max Lerner, *Ideas Are Weapons* (New York, 1939), 152–173, for background and provocative interpretation.

[29] *Cf.* I. A. Richards, *Principles of Literary Criticism* (New York, 1930); Louise M. Rosenblatt, *Literature as Exploration* (New York, 1938).

phasis on the economic system as the backbone of society and on the desire for property as a primary human motive, that all other institutions and desires seem secondary.

Now an adequate psychological theory would show that the importance Beard ascribes to the economic system and the "acquisitive instinct," or drive for property, is largely due to their instrumental function. They operate on the whole in our society as the principal means for gratifying such diverse human wants and needs as food, shelter, mating, a rich family life, social prestige, the desire for power, security against want and humiliation, leisure, education, the cultivation of the arts, sciences, literature and philosophy. A critical study of human ends and means, of men's emotional drives, motivations, and incentives in relation to the instruments for satisfying them, would avoid both the unrealistic sentimentalism of ivory-tower idealists and the myopic vision of technicians, by insisting that all ideals have a natural basis and all instruments definite uses and ends.[30]

A set of such clearly worked-out guiding psychological principles would make the historical characters treated by Beard more rounded and complex. It would lead to closer examination of the different values in American society, their human origins and functions; the satisfactions achieved, the frustrations incurred and borne. Comparisons with other societies, primitive and civilized —Japan for instance, in which similar economic mechanisms have been used for different cultural ends—would bring out vividly the necessity for seeing all institutions in relation to the entire pattern of culture in which they function.[31] The total impression of the American scene would be equally impressive, but less stark, more revealing of inner urges and deep-laid emotional patterns.

Beard, in short, has given us an epic in the spirit of Lucretius: *Felix qui potuit rerum cognoscere causas.* He has revealed mechanisms underlying the seemingly inexorable march of events and has given us the best sense of seeing the whole of American society evolve before our eyes that any historian has yet achieved. Yet

[30] *Cf.* John Dewey, *Freedom and Culture* (New York, 1939), 74–102, and *Theory of Valuation* (Chicago, 1939), 33–50.

[31] *Cf.* Emil Lederer and Emy Lederer-Seidler, *Japan in Transition* (New Haven, 1938); Robert S. Lynd, *Knowledge for What?* (Princeton, 1939), 11–113, 202–251; Margaret Mead, ed., *Cooperation and Competition among Primitive Peoples* (New York, 1937), 1–19, 458–516.

we Faustian moderns, unable ourselves to bend the bow of Ulysses, would have him also be a rival of Flaubert or Dostoievski in subtlety of psychological portraiture, and of Dewey and Veblen in profundity of philosophical and economic analysis.

Like Beard and Turner, Parrington is one of the great seminal minds of our age in history, a pioneer in interpretation and synthesis, a thinker whose insights have become part of our cultural heritage. His *Main Currents in American Thought*, though left tragically incomplete near the end by his untimely death, is more than a history of American liberalism and radicalism, skillfully portrayed against the background of the changing American scene, in sharp opposition to the forces of political and economic conservatism. It is a masterpiece of literary art and historical recreation. The incisiveness of Parrington's portraits, his brilliant characterization of periods and cultural patterns, the felicity, pungency, and freshness of his style, the cumulative power of his narrative, have made his volumes live as few works in scholarship do.

Yet inadequacies exist in his work that must be pointed out if any advance on his achievements is to be made. His method consisted in carefully selecting the representative figures in American history who were the intellectual spokesmen of their age, section, and class, depicting their character and philosophy as related to the outstanding questions of the day, and then giving a critical evaluation of their lives and influence. The artistry of his performance, the vividness with which he evoked the past, the force and clarity of his judgments on the merits of individuals and ideas are such that few readers stop to reflect that they are not getting an equally thorough exploration of the psychological sources of the philosophies and events passed in review.

Parrington, of course, had keen psychological insights, as his observations on the abnormalities of Cotton Mather, Edgar Allan Poe and Margaret Fuller, on Melville's frustrated love for his mother, Hawthorne's fear of sex, and Jay Cooke's technique of mass salesmanship, indicate. But these and other points made by Parrington are scattered, not systematic. Although an intensely socially conscious philosopher and an economic determinist in his historical method, he was an individualist in his psychology. His analyses of the life-histories and personality-patterns of the individuals he studies were not cumulative; his evaluations of their frustrations and satisfactions, complexes and drives, were not sus-

tained. Yet unless one understands the sensitivities, desires, and needs developed in people by their social environment, one cannot understand fully the causal relation between their temperaments and the philosophies they advocate, the courses of action they take.[32]

Fruitful investigation by controlled psycho-analytic methods might have been made by Parrington, for instance, of the impetus given by the frustration of a Samuel Adams, a Thomas Paine, and an Abraham Lincoln through poverty or marital unhappiness to their embarking on a political career. He might also have explored the relationship between Alexander Hamilton's glorification of *Machtpolitik* and the desire for power he derived, in part, from the illegitimacy of his birth. Inconsistencies like Hamilton's defense of the Constitution and his criticism of the class basis of agrarian radicalism could have been explained in terms of rationalization as expounded by Freud and Pareto. The cynical disparagement by Henry Adams of his intellectual achievements might have been attributed to the inferiority complex he acquired from concentration on the modal image of his grandfather and great-grandfather as Presidents of the United States. His glorification of the Middle Ages and the spiritual power of the Virgin Mary could have been interpreted not only as a reaction against the crass industrialism and political corruption of the Gilded Age, but also as a compensation for the deprivation in his personal life caused by the suicide of his wife.

Parrington might also have explored with rigor and profit the psychological mechanisms underlying the power of leaders over parties and masses, the success or failure of writers in communicating their ideas to audiences, the growth of nationalism, the forms that class and sectional conflict took, and the structure of democracy.[33] Yet incomplete as Parrington's analysis and tech-

[32] *Cf.* Charles M. Campbell, *Delusion and Belief* (Cambridge, 1936); K. Horney, *Neurotic Personality;* J. S. Plant, *Personality and the Cultural Pattern.*

[33] *Cf.* Merle Curti, "Dime Novels and the American Tradition," *Yale Review* (Summer, 1937) n.s. 26: 761–78, and "Wanted: A History of American Patriotism," *Proc. Middle States Assoc. Hist. and Soc. Sci. Teachers* (1938), 36: 15–24; Isidor Ginsburg, "National Symbolism" in Paul Kosok, *Modern Germany* (Chicago, 1933), 292–324; Karl Mannheim, *Ideology and Utopia* (New York, 1936); Roberto Michels, *Political Parties* (New York, 1915); Arthur Rosenberg, *Democracy and Socialism* (New York, 1939); Bertrand Russell, *Power* (New York, 1938); M. Sherif, "The Psychology of Slogans," *Journal of Abnormal and Social Psychology* (Oct.–Dec., 1937), 32: 450–61.

niques were, his writing recaptured a world and presented it with power and beauty.[34]

But the virtues of the great historians need no further celebration. It is the heights beyond those they conquered, the gaps in their achievements, the unexplored fields awaiting the pioneer that require attention and cultivation, now more than ever. The heartbreaking collapse of nearly all European civilization under the impact of Nazi Germany's military might has made clear what should have been evident long before to historians and social scientists. They cannot remain immured in their academic and ceremonial traditions, they must seek in addition to historical scholarship on what has happened, new light on why human beings have been or are impelled to act as they did or do. Without a more active and thorough integration of history and psychology than we have at present, we shall not understand either the deep currents of the past or the cataclysmic changes of today and the impending future. All of us can now appreciate and act on the tragic truth contained in F. H. Bradley's remark: Hell is Heaven [or the vision of the way to salvation]—that has come too late.[35]

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[34] What Santayana has said of Dante's *Divine Comedy* may be said of Parrington's work, as well as Beard's: "This is not poetry [or history] where the parts are better than the whole. Here, as in some great symphony, everything is cumulative: the movements conspire, the tension grows, the volume redoubles, the keen melody soars higher and higher; and it all ends, not with a bang, not with some casual incident, but in sustained reflection, in the sense that it has not ended, but remains by us in its totality a revelation and a resource for ever." George Santayana, *Three Philosophical Poets* (Cambridge, 1922), 132–133. For other points of view on Parrington see J. B. Harrison, *Vernon Louis Parrington, American Scholar* (Seattle, 1929); and Bernard Smith, "Parrington's Main Currents," *New Republic* (Feb. 15, 1939), 98: 40–43. *Cf.* also Charles A. Beard, "Fresh Air in American Letters," *Nation* (May 18, 1927) 124: 560–62; Granville Hicks, "The Critical Principles of V. L. Parrington," *Science and Society* (Fall, 1939) 3: 443–60; Morris R. Cohen, "Parrington's America," *New Republic* (Jan. 28, 1931) 65: 303–4, and in this journal (April, 1940) 1: 241–51 and (June, 1940) 1: 369–74.

[35] F. H. Bradley, *Aphorisms* (Oxford, 1930), No. 99.

DISCUSSION

THE SOCIOLOGY OF KNOWLEDGE AND THE PROBLEM OF TRUTH

By Gerard De Gré

In the opening article by Professor Lovejoy in the first issue of the *Journal of the History of Ideas*[1] the question has again been raised concerning the epistemological consequences of the "sociology of knowledge." In bringing this question to our attention, Mr. Lovejoy has indirectly reminded us of the necessity of distinguishing between the *sociology* of knowledge and what may be called the sociological *theory of knowledge*, a distinction which, as Mr. Lovejoy has indicated in his article, is unfortunately often overlooked by both the sociologists of knowledge themselves and their critics.

Inasmuch as the history of ideas may find a useful ally in the sociology of knowledge for the analysis of their common data, it may be advisable to devote a few pages to the consideration of the epistemological status of what are here termed *gnosio-sociological*[2] propositions, in order to clear up this question of the bearing of gnosio-sociological research on the general problem of the validity of ideas.

In order to answer this question it will be necessary to consider briefly the nature of gnosio-sociological research: the focus of interest from which it approaches its data, the conceptual tools which it may find useful, and, especially, what aspect of ideas it is with which it is primarily concerned.

As in all sociological inquiry on the interpretative level, gnosio-sociology must make some basic analytical distinctions in approaching its problems. There are first the social facts that are to be explained. For gnosio-sociology these facts are to be found in the thoughts or ideas that are explicit or implicit in communication between individuals. "Thought which is meaningful but non-sensory is communicated or expressed by language or some other symbolism; the symbolism in its turn being sensory but having in itself no meaning."[3] Consequently, although we are primarily concerned with the thoughts and ideas that play a rôle in the communicative process, we nevertheless have to approach these ideas indirectly, that is, through their concrete manifestations in language or some other symbolism. This problem,

[1] Arthur O. Lovejoy, "Reflections on the History of Ideas," *Journal of the History of Ideas*, I (1940), pp. 17–18.

[2] "Gnosio-sociology," a direct translation of the German "*Wissenssoziologie*," is suggested in this paper in preference to the somewhat cumbersome "*sociology of knowledge*." It is especially useful in that it provides an adjectival form.

[3] Grunwald, *Das Problem der Soziologie des Wissens* (Wien-Leipzig, 1934), quoted by A. H. Child in *The Problems of the Sociology of Knowledge*, Ph.D. thesis, Jan., 1939 (unpub.), University of California, Los Angeles, p. 70.

however, could well furnish a topic for a separate paper, and for the purposes of this inquiry it must suffice to have merely raised it. It must also be mentioned that gnosio-sociology is not concerned with the thought of a theoretically isolated individual existing in a social vacuum, but with the knowledge of concrete persons who are members of social groups, and who orient their thinking to other persons by attempting to communicate or express their ideas in some overt manner by either embodying them in language or expressing them in gesture, ritual or art.

The second level of interpretation concerns itself primarily with the meaningful and understandable aspects of the social facts to be explained. We attempt to relate the concrete particular thoughts expressed by individuals to their more basic underlying world-conception (*Weltanschauung*), ultimate values, interests, beliefs and sentiments. We endeavor to penetrate through the individual's external behavior and isolated concrete statements in order to discover the basic complex of ideas and the motivations involved in his action. It is only in so far as we succeed in doing this that we can *understand* the *subjective meaning,* that is, the meaning of the propositions *for the individual who states them.*

The subjective content, and the *acts* of judgment through which individuals arrive at their ideas, must be distinguished from the *truth-value* of a proposition, that is, its correspondence with actual facts or its formal logical validity. Gnosio-sociology is not concerned with this latter aspect of the ideas with which it deals. It is not concerned with what a proposition says about something, only with what a proposition may tell us about someone. It is not the function of gnosio-sociology to pass value judgments as to the intrinsic truth, worth, beauty, or comparative value or validity of the thought-products with which it deals; but merely to establish on a purely sociological level the functional, causal, structural or meaningful relationships that it may find amongst its data.

The gnosio-sociologist, however, is not merely concerned with understanding the meaningful elements in knowledge, he must also, as a sociologist, attempt to relate these meaningful complexes to the socio-historical conditions within which they occur. For example, it is not enough to demonstrate that a particular literary work is the product of a deeply rooted resentment that the author has for certain social strata; we must go further and discover the sociological genesis of this resentment within the system of social stratification with which the author found himself confronted, the prestige and privileges of the group of which he was a member, the accepted currents of thought which were pervasive in his society, and the clash of ultimate values characteristic of his group as opposed to that of some other group.[4]

[4] *Cf.* Max Scheler, *L'Homme du Ressentiment,* authorized translation, (Librairie Gallimard, Paris, 1933).

All three of these elements are necessary to arrive at an adequate sociological explanation: the social actions which provide us with our data, the interpretation of the social actions in order to make them understandable and meaningful, and the causal, functional and structural investigation of the socio-historical situations in which social actions occur and the subjective orientations of the individuals arise. These elements, however, are characteristic of all sociological interpretation which attempts to do justice both to the causal and meaningful aspects of social action, and not of the sociology of knowledge alone. We shall now turn, therefore, to the consideration of their application to the problems that are the particular concern of the sociology of knowledge.

There is first the problem why in certain social situations specific aspects of experience are stressed more than others. This is not a semantic problem, that is, we do not ask what is the relationship between thought-products and the external facts to which they may refer, but rather what are the societal factors that influence the *selection* of a particular subject-matter by those who make statements about their experience. For example, we may ask: "How did the socio-historical situation of the Middle Ages condition the widespread preoccupation with the problems of the Kingdom of God and the salvation of the soul?"

Secondly, we are interested in discovering the social roots of the manner in which experience is interpreted. We must search for the concrete ideas that give us an insight into the ultimate values, sentiments, interests, beliefs and attitudes that influence the perspective or meaningful orientation of persons to their experience. These factors must then be related to the sociological factors existing in the historical situations in which they are found. Karl Mannheim's discussion of what he calls the ideological and utopian mentalities may illustrate this focus of interest. These constructs are heuristically constructed generalizations and are not restricted to any particular socio-historical situation. By an "ideological" mentality is meant, in Mannheim's perhaps unfortunate terminology, a social perspective that is so much concerned with preserving the existing social and political arrangements that it is blind to any factors that might tend to disrupt or invalidate them. In contrast, the "utopian" mentality is so obsessed with the idea of destroying the existing social order that it cannot see any of the valid or useful aspects that inhere in it.[5] These two constructs represent two differing perspectives through which experience may be interpreted, and towards which divergent social groups may respectively gravitate. The gnosio-sociological problem would concern itself both with the social conditions that influence groups to gravitate towards one or the other of these mentalities, and with demonstrating how particular concrete thoughts may be functions of these more general perspectives.

[5] *Cf.* Karl Mannheim, *Ideology and Utopia,* New York, Harcourt Brace & Co., 1936, esp. p. 36.

A third problem lies in the investigation of the societal factors influencing the most general concepts of knowledge, particularly what are called the categories: space, time, number, causality, relation, being, etc., as well as the general concepts of science, philosophy, theology, law, art and literary criticism, and morals. For example, it may be asked: "Why did the Chinese at a certain period of their history develop *that kind* of conception of number?" The "why" in this question refers to the social context of an occurrence. The answer to this question would be couched in sociological-meaningful terms, *i.e.*, with reference to certain social relationships, institutions, currents of thought, common attitudes, etc., which exercise a specific influence on the members of certain strata of Chinese society. This is what Marcel Granet attempts to do when he analyses the social factors which condition the qualitative conception of hierarchical essences pertaining to numbers that was characteristic of Chinese mathematical theory.[6] On a somewhat more mundane level we may investigate the rôle played in societies by highly charged concepts such as Communism, Democracy, Fascism, Freedom, Equality, Aryan Supremacy, International Finance, etc., when used as hypostatized entities and associated with deeply rooted emotions, prejudices, ideals or interests. Two problems may be raised in regard to these concepts: 1. How is the genesis, meaning or acceptability of these concepts conditioned by the social situations in which they operate?, and 2. How do these concepts influence social adjustments and condition men's mutual orientation to one another?

Finally, gnosio-sociology is interested in discovering the reciprocal influence of socio-historical conditions and the most general structure of thinking on the logical and formal level. Certain rules are set up during the course of time by social groups as to how valid knowledge is to be acquired, and how propositions are to be logically operated with. Gnosio-sociology is interested in the social situations in which these rules were developed and in the influence of these rules on social action. We may ask, for example: "What were the social and intellectual conditions existing in Germany that account for the reception of Roman jurisprudence and its displacement of the old German folk-law, starting with the sixteenth century onward?",[7] or "What were the conditions in the later Middle Ages that made the synthesis of medieval and Aristotelian thinking so successful for the social and intellectual purposes of that period?"

It will be observed that in all of these procedures gnosio-sociology never raises the question of the material truth or logical validity of the ideas or of the thought-systems that provide its subject matter. Ideas and idea-com-

[6] *Cf.* Marcel Granet, *La Pensée Chinoise* (Paris, 1934) especially Book II, Chapter 3.

[7] *Cf.* Eugen Ehrlich, *Fundamental Principles of the Sociology of Law*, Harvard University Press, Cambridge, 1936, especially Chapter III.

plexes may be treated as symbolic adjustments[8] made to the world of experience by individuals within and conditioned by social situations. The sociology of knowledge regards these thought-products as different possible ways through which thinking beings interpret, know, or attempt to control reality, and adjust their existence to the flux of phenomena in which they participate. All of these thought-patterns are symbolic: some poetic and imaginative; others dogmatic, normative, regulative, or philosophic; still others empirical and logico-experimental. Some have their value in the world of action and politics, others in so far as they reflect the structure of reality. The type of reality about which the ideas attempt to enlighten us does not concern the gnosio-sociologist on an epistemological or ontological level of analysis. It may be real or illusory, material or spiritual, sacred or profane, empirical or transcendental; with regard to these distinctions gnosio-sociology strives to be non-evaluative, and makes every effort to avoid passing value judgments as to the intrinsic superiority of science over mythology, or the "higher" truth of religion as compared to the "mere" experiential truth of science. "Knowledge" in the context of gnosio-sociology is a non-evaluative term and carries with it no implications as to the truth or falsity of that knowledge.

At all stages of gnosio-sociological research we are concerned only with establishing a relationship between ideas and men, and not between statements and reality (material truth), nor between statements and other statements on a strictly logical level (formal truth). That is, we are not concerned with establishing the material or formal validity of the ideas and thought-systems with which we deal as our subject matter, but only in discovering their *subjective meaning* for the human agents involved, and in relating the acts of judgment through which these subjective meanings arise to certain more pervasive currents of thought, affective complexes, and the social situations which condition them.

The gnosio-sociologist is interested in how the problems that knowledge attempts to solve reflect the problems with which a social group is faced. He may describe how the structure of men's societies influences the structure of their thought. He may show why certain parts of men's experience become more vital to them at some times rather than others. And he may even attempt to demonstrate that certain of their thought-structures have lost their utility for purposes of certain practical adjustments, or operate to inhibit the most efficient solution of specific problems; but even in this last case the gnosio-sociologist is relating ideas to persons, and not ideas to the objects to which they may refer. Any epistemological implications that may be found in these observations may be of concern to the philosopher, but not to the sociologist. The utmost that gnosio-sociology may contribute

[8] Symbolic in so far as thinking, particularly that type of thought usually associated with knowledge, takes place mainly through the mediation of language, and consequently, through the symbols of language.

to the general theory of knowledge is to demonstrate the sociological limits within which a conceptual position can hope to attain acceptance. That is, it may demonstrate within a sociological frame of reference, and in terms of the human agents who do the thinking, who are limited by their social heritage and the structure of the society in which they exist, why specific ideas are not likely to attain complete acceptability by all men at all times and under all social conditions; and why no particular individual can possibly attain a total picture of reality which would include all possible human points of view. The laity expresses this fact in its adage: "A man is a product of his times."

However, the demonstration of the limiting factors in the perspectives of thinkers and the multiplicity of possible thought-styles does not have any bearing on the problem of the ultimate epistemological validity of what these thinkers *do say* about that limited part of the total reality with which they *are concerned.*

The sociological *theory of knowledge,* as contrasted with the *sociology* of knowledge, however, is an epistemological position which attempts to infer from the findings of gnosio-sociology certain hypotheses concerning the relationship between propositions and *that which* the propositions are about. Of such a nature are the statements of Durkheim about the social locus of the referents of the categories and other ideas. If this position is pushed far enough it results in a kind of *social idealism* which posits that, although the "world" is not the "idea" of any specific individual, as some of the subjective idealists have maintained, it is a kind of "collective idea" and exists only in the "collective consciousness." When Durkheim or other sociologists make statements of this kind they are no longer speaking *quâ* sociologists, but *quâ* epistemologists. Such epistemological statements must be carefully distinguished from the preliminary gnosio-sociological analysis that Durkheim makes of the social factors, such as religious festivals, kin and clan groups, the spatial arrangements of villages, etc., that influence the primitive conceptions of the categories of time, space, causality, etc.[9]

If this distinction between the sociological theory of knowledge and the sociology of knowledge is carefully maintained, and the exclusive reference of gnosio-sociological propositions to the relationships between thoughts and thinkers, and *not* thoughts and facts, is kept in mind, this confusion—which is always cropping up with reference to gnosio-sociological research and its supposed trespassing on the precincts of epistemology—will be finally cleared up, to the mutual benefit of both the sociologists of knowledge and those other thinkers who are concerned with the analysis, interpretation, or history of ideas.

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[9] Emile Durkheim, *The Elementary Forms of the Religious Life,* New York, The Macmillan Co., 1915, especially pp. 1–28, 200–222, 268–292, 518–528 and 609–638.

BOOK REVIEW

NEW ENGLAND: INDIAN SUMMER. By Van Wyck Brooks. New York: E. P. Dutton & Company, Inc., 1940. Pp. 557. $3.75.

In *New England: Indian Summer*[1] Van Wyck Brooks carries on his story in substantially the manner of *The Flowering of New England*, once more winning popular acclaim, and astonishing those who remember the austere intellectualism of *America's Coming-of-Age*, his dour and humorless disquisition on Mark Twain, his severe strictures on Henry James. In this volume, as in its predecessor, severity is banished, and humor peeps from behind every bush; there is warmth and spaciousness, a wealth of human detail, a series of sympathetic portraits; there are episodes, anecdotes, and scenes which, once Mr. Brooks has told them, will remain in the memories of his readers, and in this form furnish a vivid dramatic content for a period of American literature.

The success of these volumes is in no small part a result of their novelty. They are like nothing else in the field of literary studies, and they do not fit into any of the conventional rubrics. Mr. Brooks says this volume is a portion of his sketch of the history of American literature; he has been hailed as a critic; his design has called for a presentation of New England society in historical terms; he called the earlier book a study of "the New England mind" and he still makes great use of the phrase. Thus the book appears at one and the same time as literary history, criticism, social history, and intellectual history, and yet is no one of these things alone. It cuts across the boundaries of formal disciplines, or else mixes the elements in a unique fashion; and we are driven to ask ourselves, before we can fully understand the work, whether we must not invent some entirely new classification. Considering that it probably will raise up a host of imitators, the book calls for thoughtful consideration by all who work with the materials of the past.

If the book cannot be placed in any of the familiar genera it must be described for what it is, and this is not an easy task, for much of its distinctive quality results from a subtle and evanescent rhetoric, delicate and fragile and so peculiar to Mr. Brooks that any characterization of it in concise and conventional terms would do it violence. In the main, the book is an imaginative re-creation of the authors and artists in their habit as they lived—how they talked and walked, where they lived, what they wore, even what they ate. It is compact of details, often trivial, of meetings, of houses, of friendships; it is a series of vignettes, a kaleidoscope of glimpses and tableaus, merging one into another, arranged in a sequence that is determined by no principle of logic or even of chronology, but rather by some

[1] The point of view maintained in this notice is my own, but I am indebted to a recent discussion of the volume in my seminar and have had the benefit of the comments of its members.

secret rule of pictorial composition, a principle of balance and symmetry. The figures are grouped within the canvas like figures in the *stanze* of Raphael, as in The School of Athens, the great ones high-lighted in the center, the lesser ones draped off at the sides in subordinate but supporting postures. Though Mr. Brooks does talk of contrasts between succeeding decades, much of the book has a strangely static effect; each episode stands by itself, eternally transfixed, sculptured and vaguely symbolic. The characters are always captured in attitudes that seem to reveal larger significances. The tone is soft and mournful; the book is an elegy, a sustained threnody, a lament upon the decay of New England, its gentle descent into somnolence, exhaustion, and sterility. The men and women are laid to rest, delicately wrapped and embalmed, preserved in an exquisite prose of falling cadences. Sentences begin with "and," "for," "as"; the great days fade out of sight and then out of memory: country life shrivels, the New England mind cuts its ancient moorings, Harvard men abandon the classics, the dreams of idealistic youth vanish, the old order passes, and the refrain sounds forever and monotonously that we are no longer in the world of Emerson and Hawthorne, but of Wendell, Aldrich, Woodberry, and the diminutive "epigoni." Even the greatest of the New Englanders at the end of the century are represented as universally finding in the literature of Buddhism "a message of resignation, peace, passivity, inactivity that appealed to the tired minds of this later New England" (p. 360). The note of weariness and lassitude sounds unceasingly; the book is a deepening funeral march, to the solemn strains of which the authors move in procession to the grave, until at the lowest ebb of vitality a new generation suddenly appears at the New England colleges to sound the strains of a countertheme, a reveille, and the book ends triumphantly with a hymn of praise to Robert Frost.

To the accompaniment of this mournful music the panorama of the age is quietly unrolled, and the characters pass before the reader in immensely meticulous detail, surrounded by their friends, seated at their desks, Henry Adams with three terriers tumbling about his horse's hooves, Celia Thaxter painting porcelain at the window, Frank Bolles and Bradford Torrey meeting in pitch darkness as they spy upon the April snipe, Sarah Jewett in smoke-browned kitchens, and Aldrich with his waxed moustache. The focus of the book is so concentrated upon the array of episodes and minutiae that the author seems almost non-existent. He is the unseen manager, the prompter in the wings, who dispatches the characters one after another across the stage, but whose presence is felt only in the ordering of the program and the control of the spot-light. He never appears before the curtain to expound the meaning or to tell you what to watch for; the actors themselves embody the story and speak their own lines, to such an extent that page after page is compacted out of their own writings, phrases knit together or sentences paraphrased, but still their own words and not those

of Mr. Brooks. So much does the book consist of the show itself, of the procession of characters and their "props," that it might be classified, if classified it must be, as an animated guide-book to literary New England. Mr. Brooks says that the novels of Marion Crawford were prized by travellers in Europe because, wherever they might go, Crawford had written a story "that gave a third dimension to Baedeker's dry notations and enabled one's fancy to share in the life of the people" (p. 306). Mr. Brooks has supplied, in analogous fashion, a third dimension for a literary pilgrimage to historic New England and the homes of its authors.

This may seem a bit harsh, but surely the book cannot be called literary history in any of the accepted connotations, in spite of Mr. Brooks's assertion, for it is compact of personalities, biographies, and trivialities of daily life, only incidentally of works of literature. In many cases important writings are not even named; few books or poems get more than a sentence, and there is little concern with literary forms or with intellectual fashions. Significantly, the index consists exclusively of proper names; an index of writings would be pointless, for few are mentioned except in passing and the comment is always fleeting. It is equally inappropriate to call the book a work of criticism. Mr. Brooks, keeping himself modestly concealed in the wings of his theatre, never expounds or analyzes or performs any of the functions customarily associated with the critic. His generalizations are few; they are either repetitions of his theme of decay and decline, or else comments of a purely descriptive sort. Assuredly a critic must say something more of Parkman than that, while he understood the French and English, "his imagination failed him only with the Indians" (p. 182), or of Emily Dickinson, as a last pronouncement, "Where others merely glowed, she was incandescent" (p. 329). So fascinated does Mr. Brooks become with managing his dramatic narrative that his remarks upon many of the actual writings are wholly misleading. John Fiske the robust human being is one thing, but John Fiske the historian is another story, and his works are not at all what Mr. Brooks would make them out to be. We may pardonably wonder against what background he is viewing his people when he says that the Puritans who conquered the Indians had not poured scorn on the red men for their forest-existence and that "the Puritans were not rhetoricians" (p. 412); as it happens, the Puritans were decidedly rhetoricians, and they seldom lost an opportunity to pour scorn upon all varieties of "forest-existence." Mr. Brooks declares that Henry James found manners but not morals important, and several students of James, among whom I should fervently wish to be numbered, are forced to a flat contradiction. They may be wrong when they hold that his novels are, like the dialogues of Plato, disquisitions upon the nature of true virtue, of perfect beauty, and the absolute good, but if Mr. Brooks's volume were a work of literary criticism it would have to face the challenge of their belief. It does not face such a challenge; instead it finds in the stories of Henry

James the image of a man who was habitually embarrassed and showed it in evasiveness and hesitancy. Only the sensationalism which is today so widespread in literary journalism can account for the fact that such biographical impressionism is greeted as literary criticism.

Many of Mr. Brooks's pages appear to be social history; there are long discourses on the characteristics of the American girl or the American in Europe. Yet they are not truly historical studies; they are straight out of the books, usually from the novels. They are not descriptions of actual American girls, but the American girl as she exists in Howells's novels; not actually of American travellers, but of the character of the traveller as portrayed by James. If, as a critic, Mr. Brooks is open to the charge of not taking the literature seriously enough to talk about it, when he comes to delivering pronouncements upon society he seems to take literature with a deadly seriousness, or at least to take it without qualification at face value. We wonder what he thinks he is doing when he declares, for instance, that American aristocracy had not evolved in native forms, and then reveals in a foot-note (in this volume, as contrasted with *The Flowering*, Mr. Brooks supplies in foot-notes the sources for many of his sentences) that this large sociological observation is a paraphrase of a remark by a character in Howells. We can only conclude, in the face of many such instances, that Mr. Brooks's pages on society and the historical background are not intended to give an account of the period as actuality, but only as it appeared to his authors; though he leaves us with an uncomfortable suspicion that perhaps to him the two accounts are one and the same.

Regarded as intellectual history the book is exasperating and incomplete. Ideas are mentioned only as they emerge from the résumés; they are passed over lightly, they are not defined or analyzed, they appear and disappear in the convolutions of the style and the interplay of personalities. Some of the difficulty may result from the fact that New England in the post-Civil War decades is not an isolable culture, as it was during the Colonial or Romantic eras, and that therefore the intellectual forces with which Mr. Brooks must deal are not regional. Hence he does not discuss them except as they worked certain effects within the regional picture. His discussion of Bellamy, for example (pp. 383–388), emphasizes the "gadgets" which Bellamy found in Utopia and his anticipations of H. G. Wells, all of which Mr. Brooks treats as a reflection of the urbanization of New England. Nothing whatsoever is said about Bellamy's economic ideas, of his sources, or his relationship to the many other Utopians of the eighties and nineties; the important passages in *Looking Backward*, such as the analogy of the coach, evaporate somewhere in Mr. Brooks's treatment, and the slight residue is of little importance for illustrating the intellectual currents of the age. One could, in fact, list what might be called the dominant ideas in American culture between 1865 and 1920, only to discover that most of them are conspicuously not mentioned by Mr. Brooks, and that the others

are indicated only by name. The ideas that underlie the local-color conventions, the religious ideas, the actual arguments for and against Darwinism, the popularizations of scientific discoveries, the various brands of social theory, the concepts of politics or the catchwords of politicians—we find nothing or next to nothing concerning these matters in *New England: Indian Summer,* just as in *The Flowering of New England* we found no precise definition of the distinction between Reason and Understanding, of the doctrine of Correspondence, or of the Transient and Permanent. At best Mr. Brooks indicates the mere existence of intellectual issues only when he summarizes a book that touched upon them; any idea that happened to be the material of an author may be designated if the designation happens also to fit in with Mr. Brooks's descriptive purpose, but nothing more is said about it. There is no effort to get behind the surface appearances, to define common purposes or derivations, to make clear the meanings or the internal structures of the thought. Considered as intellectual history, the book exhibits a basic deficiency which might be put roughly thus: Mr. Brooks has little sense of the inter-relations and interplay of the ideas he finds in his authors; they are all on the same level, they are what this or that person said; and consequently he has no way of indicating the *tensions* that did or could exist among them. The conflicts among minds and the struggles within particular minds are played down to a hush, and the figures move through the book, despite the wealth of physical detail, as though on muffled feet. Dramatic enough, in one sense, the book largely misses the central plot of the action it relates—the drama of ideas.

To examine *New England: Indian Summer* from these four points of view is perhaps after all to say nothing about the book itself, but merely to reflect upon what it might have been had Mr. Brooks intended it to be either a critical study or one of three varieties of historical interpretation. It obviously was written with no such intention; but the subjecting of it to analysis under these lights has at least this virtue, that in every case there arises a question whether the book has any standard of judgment. It appears to trust to the flow of the material itself, to keep the author in the background, as though the book had written itself. Mr. Brooks usually avoids specific criticism, he ignores social history beyond whatever documentation chances to come out of the literature, he disregards literary currents and forms, and he makes no attempt to define or appraise ideas. Yet when all this is said, one must recognize that the book did not write itself. Mr. Brooks is very much the author, and he does have a point of view, which completely determines his use of the material. He is not as artless as he appears, and a philosophical position is implicit in his technique. If his function has been largely that of the manager, he has at least regulated the entrances and exits of his characters, contrived the transitions and changes of scene, and reiterated emphatically a theme of decay and disintegration. He has left out of account every historical or critical reflection that might interfere with this preconceived effect. He has, for instance, manipulated

his presentation so that by the time we come to "Boston in the Nineties" and "The Epigoni" we get the chapters that concentrate on the emptiest, the most insignificant of his figures, so that the effect of a dead-end, of the nadir of a culture, is complete, even though the greater writers he has already discussed were mostly still alive in the nineties, and many of them doing their best work. And thus the stage is set for the drama of renaissance, for the appearance of the new generation that came to Harvard or Yale at the lowest point in the decline, and began the revolt against genteel decadence of which Mr. Brooks himself has been one of the chief spokesmen.

When the book is seen in this light it yields up its secret, as it will not when examined as a work either of criticism or of history. Just as the student of literature must complain of the superficiality of Mr. Brooks's critical judgments, the historian must object both to his main factual generalization and to his causal explanations. Writers in New England before the Civil War were great, Mr. Brooks declares, because they had grown in the tradition of the Revolution and had causes to fight for, because they were connected with the soil, and because they read the classics (p. 13); after the Civil War the writers had no causes, they were urbanized, and, thanks to President Eliot, they no longer read the classics. For these reasons the generation of 1870 became "restless, cynical, sceptical, doubtful, self-conscious, apprehensive and torn by scruples," by the scruples which devour men who have no large impersonal interests and no "instinctive connection with primary things" (p. 201). As a literary judgment upon a whole complex period this passage is dogmatic and infinitely controvertible; as an explanation of causes it is inadequate and peripheral. But as a revelation of Mr. Brooks's system of values, of his opinion of these writers and the reasons why he thinks them deficient, it is exhaustive and definitive. Here, therefore, is Mr. Brooks's standard, the principle upon which the book is in fact composed—not a standard of form or a conception of historical process, but a moral standard, a conception of the good life, a Platonic archetype of a healthy culture, which is indeed fixed and timeless, which the particular age under discussion failed to exemplify, and, because it thus failed, was ineluctably doomed to cynicism and scruples. No wonder the book plays down temporal and causal factors and does not examine ideas in the contemporaneous context, that it skims over the virtues and defects of particular works, that it is content with summary and paraphrase. It is neither a sketch of American literary history nor a study of the New England mind; it is a testing of a group of writers, taken as they stand by themselves, apart from time and place, by the touchstone of Mr. Brooks's idealism. In this case the authors as a group are found wanting, as in *The Flowering* they were found good. Mr. Brooks is not endeavoring to tell how or why things happened, but he is using the past for purposes of his own, to set forth the language of his soul in a cleverly contrived selection from the lives and words of these writers. It was Mr. Brooks, we should remember, who talked eloquently several years back about a "usable past."

One cannot grudge Mr. Brooks the right to compose any kind of book he wishes; but it is necessary to be clear as to the nature of his undertaking and of the preconceptions he brings to it. It would, doubtless, be an exaggeration to see in the book the sign of a widespread "tendency." Mr. Brooks has always been uniquely himself and continues to be. No doubt the net effect of the book will be good; it will keep alive the memory of many worthies who otherwise might be undeservedly forgotten, and it may set many persons to reading the writings he enumerates. But I, for one, cannot help wondering if the book after all makes a legitimate "use" of the past, if it is not, when all is said, a misuse. I am reminded of other dispositions in the modern world to renounce the discipline of understanding the past in its own terms, to swing free in time and space, to reorganize experience not in the categories which did in fact arise out of it but in the *a priori* categories of an ethical or political system. With some of these current dispositions Mr. Brooks is, as we know, in disagreement, but the question remains whether, once a man has set himself to manipulate and regulate the material of the past in order to convey a private ethics, to disregard historical factors of cause or influence, to capitalize upon the books of others in order to state not their but his own meanings, he does not set an ominous example for those who—with quite other preconceptions—would also make over the picture of the past into something they have predetermined it should be. Architects who designed the west fronts of medieval cathedrals and sculptors who filled the columns and tympanums with exquisite figures achieved great works of art; they made Abraham and Mary and Judas into symbols of the spirit and emblems of a hierarchy of intellectual values. But they disregarded history as they foreshortened perspective, and filled their spaces with stylized images according to the dictates of their belief, not of factual record. Their characters had lost historical meanings, and to the artists as to the beholders existed only as symbols within the schematic framework of theology. But Mr. Brooks's characters are not mythological; they are still individuals in a spatial and temporal context. Medieval biographers could treat their subjects mythologically without laying themselves open to the charge of irresponsibility because they labored in the service of a great and universal creed. I cannot discern behind the façade of Mr. Brooks's dramatization a creed of similar magnitude, and I can see hope for the human mind only when it will learn from the past what experience has been in reality, not what it may be made to symbolize. If Mr. Brooks's volume does represent a tendency, then it is one which those who devote themselves to the search of truth as it can be found in records and literature, especially those who hope to understand the ideas and configurations of ideas in which men have variously seen and comprehended their experience, must be prepared to resist.

PERRY MILLER

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BOOKS RECEIVED

HISTORY OF LITERATURE

THE ANCIENT GREEKS. Studies toward a Better Understanding of the Ancient World. By William Kelly Prentice. Princeton: Princeton University Press. London: Oxford University Press, 1940. Pp. viii, 254. $3.00.—"A good many statements in the ancient literature have been discredited and discarded, and that has made a great difference in our knowledge of the past. We know now that many of the Classical authors were rather superficial and inaccurate persons, as a good many modern authors are: some of their assertions were based on conjecture or false reasoning, not on any sort of record, some were perversions of the facts because of ignorance or prejudice or personal bias."

ORATIO IN LAUDEM ARTIS POETICAE (*Circa* 1572). By John Rainolds. Princeton: Princeton University Press, 1940. Princeton Studies in English, No. 20. Pp. 93. $1.50.—With an introduction and commentary by William Ringler and an English translation by William Allen, Jr.

UNPATHED WATERS. By Robert Ralston Cawley. Princeton: Princeton University Press, 1940. Pp. viii, 285. $3.75.—What the Ancient World and the Middle Ages bequeathed to Renaissance literature in the way of voyaging traditions, including a study of the early and later maps and voyagers and how the material abundantly provided by the voyagers was utilized by characteristic literary figures (Greene, Dekker, Beaumont and Fletcher, Heywood, Shakespeare, Bacon, Davenant).

ADVERSITY'S NOBLEMEN. The Italian Humanists on Happiness. By Charles Edward Trinkaus. Studies in History, Economics and Public Law, No. 475. New York: Columbia University Press, 1940. Pp. 172. $2.00.—This book treats of the character and cultural significance of the attitude towards happiness of the Italian humanists, as represented by selected Italian writers from the fourteenth to the sixteenth century. The intensity of their fidelity to classical and Renaissance ideals, as compared with certain Christian medieval considerations of happiness, varied greatly.

THE STATE IN SHAKESPEARE'S GREEK AND ROMAN PLAYS. By James E. Phillips, Jr. New York: Columbia University Press, 1940. Pp. ix, 230. $2.75.—The political ideas which appear in Shakespeare's Greek and Roman plays are found to be consistently those that were accepted generally by conservative and orthodox thinkers of his day, those that the general populace knew and accepted without question.

THE AESTHETIC THEORY OF THOMAS HOBBES. With Special Reference to His Contribution to the Psychological Approach to English Literary Criticism. By Clarence DeWitt Thorpe. Ann Arbor: The University of Michigan Press, 1940.—"Hobbes's aesthetic theory is bound up with his philosophy, and much of his philosophy—virtually all of its civil and moral parts—is founded in psychology. To understand his ideas and to perceive the nature and force and extent of their influence on succeeding literary theory is, I confidently believe, to hold one of the most valuable clues to the development of late seventeenth- and eighteenth-century criticism."

A Revolution in European Poetry 1660–1900. By Emery Neff. New York: Columbia University Press, 1940. Pp. xi, 279. $3.00—A history of European culture since the Renaissance through the medium of English, French, German, and Italian poetry. The appendix tabulates a comparative chronology of poetic works, events, and sources of ideas.

Tradition and Romanticism. Studies in English Poetry from Chaucer to W. B. Yeats. By B. Ifor Evans. New York: Longmans, Green and Co., 1940. Pp. 213. $2.00.—A study of the English poets who have modified the conception of poetry in successive ages. "Romanticism" does not mean the same for English poetry as for French and German.

A History of the Romantic Movement in Spain. By E. Allison Peers. Cambridge: at The University Press. New York: The Macmillan Company, 1940. Vol. I. Pp. xxvi, 349; Vol. II. Pp. xii, 470. $12.00.—A study of (1) the greater figures of Spanish Romantic literature, notably Rivas; (2) the influence of foreign authors, German, French, English and Italian; (3) the periodicals of Madrid and of the provinces; (4) the native origins of Romantic movement as indicated by Menéndez y Pelayo; (5) bibliography of the period from the "Golden Age" to 1920.

Lamartine and Romantic Unanimism. By Albert J. George. New York: Columbia University Press, 1940. Pp. 200. $2.25.—Jules Romains' term *l'unanime, le continu psychique*, a belief in a ubiquitous spiritual essence, is applied as a key concept to Lamartine's metaphysics, political and social theories, and philosophy of history.

The Rôle of the Priest on the Parisian Stage During the French Revolution. By Kenneth N. McKee. Baltimore: The Johns Hopkins Press, 1939. Pp. 126. $1.25.—"The purpose of this study is to trace the development in the character of the priest as he is presented at the various theaters in Paris from the expropriation of the clergy on the second of November, 1789, through the Thermidorian reaction and briefly down to the Concordat."

Tom Taylor and the Victorian Drama. By Winton Tolles. Columbia University Studies in English and Comparative Literature, No. 148. New York: Columbia University Press, 1940. Pp. ix, 299. $3.50.—An account of the most representative and popular English dramatist of the period from 1840 to 1880, reflecting the trends of early and mid-Victorian dramatists.

Italian Nationalism and English Letters. Figures of the Resorgimento and Victorian Men of Letters. By Harry W. Rudman. New York: Columbia University Press, 1940. Pp. 444. $3.25.—The first adequate account of the influence of the *resorgimento* on the British intellectual and literary world. It shows how much more important than the critics have hitherto indicated was the interaction of Italian politics and Victorian life and literature. At the same time it describes the repercussions in Great Britain of the dramatic incidents associated with the unification of Italy.

ENGLISH INSTITUTE ANNUAL, 1939. New York: Columbia University Press, 1940. Pp. xv, 164. $2.00.—Choosing a Topic for Research, by Carl Van Doren; The Search for English Literary Documents, by James M. Osborn; The History of Literature and the History of Thought, by Marjorie Nicolson; The Literature of the Nineteenth Century, by Howard F. Lowry; Biography in America, by Townsend Scudder; Some Problems in Editing Middle English Manuscripts, by MacEdward Leach.—Miss Nicolson in her essay presents the method of the history of ideas as a *coöperative enterprise* which recognizes no limitations and barriers of language or nation.

THE PRINTED WRITINGS OF JONATHAN EDWARDS. 1703–1758. A Bibliography By Thomas H. Johnson. Princeton: Princeton University Press, 1940. Pp. xiv, 136. $7.50.

SOCIAL AND POLITICAL HISTORY

THE ECONOMICS OF ANCIENT GREECE. By H. Michell. Cambridge: at the University Press, New York; The Macmillan Co., 1940. Pp. xi, 415. $4.00.—Greek life in the workshop, the counting-house, and in trade with other people. A re-statement in the light of modern research of the rôle of Greek sea trade, agriculture, mining, the payment of citizens, and of the theory that the Greeks despised manual labor.

INTRODUCTION TO THE CONSTITUTIONAL HISTORY OF MODERN GREECE. By Nicholas Kaltchas. Foreword by Lindsay Rogers. New York: Columbia University Press, 1940. Pp. xx, 188. $2.00.—Constitutionalism in Greece, although it has sprung from both the remembrance of liberty in the classical city-state and the more recent democracy practiced in the communal self-government permitted under the Ottoman Empire, appears to have been essentially subordinate to the spirit of nationalism.

STUDIES IN MEDIEVAL THOUGHT. By G. G. Coulton. London and New York: Thomas Nelson & Sons, Ltd., 1940. Pp. vi, 230.—Sketches of the growth of ideas from Augustine with his City of God to Cusanus with his ideas on universal toleration, including an essay on the advantages and disadvantages of Latin as an international vehicle of thought.

THE LETTERS OF SAINT BONIFACE. Translated with an Introduction by Ephraim Emerton. New York: Columbia University Press, 1940. Records of Civilization: Sources and Studies, No. 31. Pp. 204. $3.00.—This translation of the letters of Boniface is pertinent to the cultural history of Frankland in the eighth century and the expansion of Christian civilization east of the Rhine.

MILITANT ON EARTH. Twenty Centuries of the Spread of Christianity. By E. R. Hardy, Jr. New York: Oxford University Press, 1940. $3.00.—A history of missions and of the spread of Christianity as an institution, *ecclesia militans*, with its numerical growth and decline in the face of the opposition of Mohammedanism, the modern secular outlook, and modern political creeds.

INDUSTRY AND GOVERNMENT IN FRANCE AND ENGLAND 1540–1640. By John U. Nef. Philadelphia: The American Philosophical Society, 1940. Pp. x, 162. $2.00. —The early English industrial revolution is said to account for the triumph of constitutional government in England, while in France the slower progress of heavy industry helps to explain the triumph of royal absolutism.

POLITICAL AND SOCIAL GROWTH OF THE AMERICAN PEOPLE, 1492–1865. By Homer C. Hockett. Third Edition, revised. New York: The Macmillan Company, 1940. Pp. v, 861. $3.25.—An introductory text.

HISTORY OF THE UNIVERSITY OF PENNSYLVANIA, 1740–1940. By Edward Potts Cheyney. Philadelphia: University of Pennsylvania Press, 1940. Pp. x, 461. $4.00.

THE UNIVERSITY OF PENNSYLVANIA TODAY. Its Buildings, Departments and Work. Edited by Cornell M. Dowlin. Philadelphia: University of Pennsylvania Press, 1940. Pp. x, 209. $1.50.

MUNICIPAL INDEBTEDNESS. A Study of the Debt-to-Property Ratio. By Leroy A. Shattuck, Jr. Johns Hopkins University Studies in Historical and Political Science. Series LVIII, No. 2. Baltimore, The Johns Hopkins Press, 1940. Pp. xiv, 145.

AGRARIAN CONFLICTS IN COLONIAL NEW YORK, 1711–1775. By Irving Mark. Studies in History, Economics and Public Law, No. 469. New York: Columbia University Press, 1940. Pp. 237. $3.00.—The causes of the social struggles of the Colonial period which have their roots in the interrelationships of economic, social, legal, and political factors. This study takes for its field the differences of landlord and small farmer in those portions of the Hudson valley which were the centers of agrarian discontent shortly before and during the Revolution.

ANGLICAN HUMANITARIANISM IN COLONIAL NEW YORK. By Frank J. Klingberg. Philadelphia: The Church Historical Society, 1940. Pp. x, 295. $3.00.— The work of the Society for the Propagation of the Gospel as gathered from its missionaries' field records among the Noble Savages of America, and from the annual sermons on native peoples preached in London (by notables like the Bishops Berkeley, Butler, Warburton, etc.) "furnish convincing evidence of the Society's humanitarian activity during the 18th century." Such "ecclesiastical records are a part of the social, political, and cultural history of the Anglo-American world."

INSURGENCY. Personalities and Politics of the Taft Era. By Kenneth W. Hechler. Studies in History, Economics and Public Law, No. 470. New York: Columbia University Press, 1940. Pp. 252. $3.00.—The Insurgent movement within the Republican party that featured the early part of Taft's administration assumed a regional form, and came to a head over tariff policy. It resulted in the termination of "Uncle Joe" Cannon's reign as Speaker of the House of Representatives.

RICHELIEU. His Rise to Power. By Carl J. Burckhardt. Translated by Edwin and Willa Muir. New York: Oxford University Press, 1940. Pp. 413. $3.75.—"Richelieu was the first modern and nationalist statesman to make use of the theory of the balance of power."

A HUNDRED YEARS OF MOUNT HOLYOKE COLLEGE. The Evolution of an Educational Ideal. By Arthur C. Cole. New Haven: Yale University Press, 1940. Pp. iv, 426. $4.00.—"The early chapters describe the curriculum of the first students and their beginnings in laboratory science, an innovation for women in those days; their experiments as cooperative home-makers; the events of their social life under the strict Victorian code."

THE MIDDLE CLASSES IN AMERICAN POLITICS. By Arthur N. Holcombe. Cambridge, Mass.: Harvard University Press, 1940. Pp. vi, 304. $2.50.—The rôle of the ideology of the middle class and its subclasses in American politics since John Adams is first traced against the historical background of European political thought and the idea of the "American way" is linked with the Kantian concept of progress. "The rural middle class was on the whole the dominant factor in national politics during the period of intersectional rivalry," and the possibility is indicated that "the urban middle class will be able likewise to dominate the political scene in the coming years."

THE AMERICAN IMPACT ON GREAT BRITAIN, 1898–1914. A Study of the United States in World History. By Richard Heathcote Heindel. Philadelphia: University of Pennsylvania Press, 1940. Pp. ix, 439. $4.00.—"I cling to the illusion that it is vitally important that the United States understand itself as a factor in world civilization. Historians have not given sufficient attention to the part we have had in European life and opinion. Quite rightly, they have studied European contributions to the United States, but have neglected, either as a problem of cultural history or as a matter of daily increasing importance, the impact of American civilization abroad. This volume, one of a projected series *The United States in World History,* was designed to be a brief part of the story of American influence on the Old World, a contribution through national history to the study of international history, and a supplement to the familiar diplomatic chronicle. The pages should contribute to many aspects of British and American personalities, and to domestic history, and add to the history of such subjects as technics, science, education, medicine and the law. It is probably one of the first efforts on a broad scale to see how one nation gets its ideas about another, and what use one nation makes of another's experience."

FROM MARX TO STALIN. A Critique of Communism. By James Edward LeRossignol. New York: Thomas Y. Crowell Company, 1940. Pp. x, 442. $3.00.—The word "communism" has had many meanings. There was the aristocratic communism of Plato's *Republic,* the elaboration of it in More's *Utopia.* The word itself was originated by the revolutionists of the Paris Commune. Today it may mean Marxian communism, syndicalism, or communistic anarchism. And it may mean one thing according to Marx, another according to Stalin. It may be one thing in theory, and another in practice.

RACE: SCIENCE AND POLITICS. By Ruth Benedict. New York: Modern Age Books, 1940. Pp. vii, 266. $2.50.—A "natural history" of racism in relation to prehistory, European expansion overseas, class conflicts, nationalism, from the standpoint of scientific anthropology confronted with theories of race based on prejudice.

THE RÔLE OF THE INDIVIDUAL IN HISTORY. By George Plekhanov. New York: International Publishers, 1940. Pp. 62.—The *Narodniks* (Populists) who accused Marxism of reducing the rôle of the individual in history to nought are answered by the claim that Marxism emphasizes the historical rôle of individuals who are outstanding by virtue of their contact with the masses and their ability to organize them and thus foresee the course of historical progress.

HISTORY OF RELIGION, PHILOSOPHY AND SCIENCE

THE GOLDEN BOUGH. A Study in Magic and Religion. By Sir James G. Frazer. New York: The Macmillan Co., 1940. Pp. xiv, 752. $1.49.—This abridged one volume version, omitting footnotes and bibliography, includes the chief topics of the original: the principles of primitive magic, social taboos, the worship of trees and cereals, myths and folklore, the fire festivals in Europe, sacred marriage, and sex practices. Thought is said to move from magic through religion to science.

GREEK POPULAR RELIGION. By Martin P. Nilsson. Lectures on the History of Religions Sponsored by The American Council of Learned Societies, New Series, No. 1. New York: Columbia University Press, 1940. Pp. xviii, 166. $2.50.—"The ways in which Greek popular religion reflected the society in which it flourished and the social changes to which it had to adjust itself."

THE CHINESE WAY IN MEDICINE. By Edward H. Hume. Baltimore: The Johns Hopkins Press, 1940. Pp. 189. $2.25.—Three lectures on the ethico-religious background of Chinese medicine (ancestor worship, Taoism, Confucianism, Buddhism), its founders and chief exemplars, and its distinctive contributions: the establishment of medical libraries and the writing of significant monographs, laying stress on treatment and physical therapy, the use of herbals, animal products and minerals, physical therapy, and careful diagnosis based on observation, especially of the pulse.

MEDICAL WORK OF THE KNIGHTS HOSPITALLERS OF SAINT JOHNS OF JERUSALEM. By Edgar E. Hume. Baltimore: The Johns Hopkins Press, 1940. Pp. xxii, 371. $3.00.—This work, which is completely documented, first appeared in the Bulletin of the Institute of the History of Medicine of the Johns Hopkins University for May, June and July 1938, Volume VI, pp. 399–466, 495–613, 617–819. There have been many additions to the text as first published. The Knights' Order was founded about 1065 in Jerusalem and has persisted in Malta (1530–1789) and through the wars of the nineteenth and twentieth centuries, caring for the wounded for "foe and friend alike."

SELECTIONS FROM HELLENISTIC PHILOSOPHY. By Gordon H. Clark. New York: F. S. Crofts & Co., 1940. Pp. viii, 267. $1.25.—Brief historical introductions precede each of the groups of selected passages from Lucretius, the Stoics (Zeno, Chrysippius), Plutarch, Philo Judaeus, Hermes Trismegistus, and Plotinus.

AN INTRODUCTION TO PHILO JUDAEUS. By Erwin R. Goodenough. New Haven: Yale University Press, 1940. Pp. xii, 223. $2.75.—Hellenistic Judaism which came to fruit in Philo of Alexandria may serve as a bridge between Greek thought and early Christianity. "While Philo's contributions to philosophy seem to be negligible, the contribution he can make to the history of philosophy in the Hellenistic period has not even been exploited."

GEORGE BOOLE'S COLLECTED LOGICAL WORKS. Vol. II. The Laws of Thought (1854). Chicago and London: The Open Court Publishing Co., 1940. Pp. xiii, 448.—A reprint of *An Investigation of the Laws of Thought on which are founded the Mathematical Theories of Logic and Probabilities.* Of especial interest still to historians of ideas are Ch. XIII "Analysis of Dr. Samuel Clarke's 'Demonstration of the Being and Attributes of God,' and of the 'Ethica Ordine Geometrico Demonstrata' of Spinoza" and Ch. XXII "On the Nature of Science, and the Constitution of the Intellect."

MARX' PHILOSOPHISCHE ENTWICKLUNG, SEIN VERHÄLTNIS ZU HEGEL, von Konrad Bekker. Verlag Oprecht: Zurich, Switzerland, 1940. Pp. 134.—A dissertation written at the University of Basel on the intellectual development of Marx as a young Hegelian (1837–1843).

THE DEVELOPMENT OF AMERICAN PHILOSOPHY. A Book of Readings. By Walter G. Muelder and Laurence Sears. Boston: Houghton Mifflin Co., 1940. Pp. x, 533. $4.00.—Selections from Edwards, Johnson, Woolman, Franklin, Jefferson, Palmer, Allen, Paine, Witherspoon, Channing, Parker, Emerson, Thoreau, Whitman, Santayana, Newcombe, Fiske, Harris, Royce, Howison, Bowne, Creighton, Perry, Mead, Peirce, James, Dewey, Lovejoy, Montague, Sellars, Woodbridge, Babbitt, Hocking, Boodin, Brightman, Hook. Introductions to each of eight periods: Early Theology and Idealism, American Enlightenment, Transcendentalism, Evolution, Later Idealism, Pragmatism and Critical Empiricism, Realism and Naturalism, Recent Perspectives.

AN ESSAY ON NATURE. By Frederick J. E. Woodbridge. New York: Columbia University Press, 1940. Pp. x, 351. $3.00.—"No reader of the history of physics ought to be surprised at the course the science is taking today even if he is surprised at the pronouncements of some of its advocates and publishers of its news. . . . Teleology and mechanism are correlative rather than opposed. . . . 'Teleology' calls attention to such facts as that origins cannot be discovered or histories portrayed unless there are specific and identifiable products or ends."

PERIODICALS AND REPRINTS RECEIVED

"The Influence of Plato on Sir Philip Sidney's *Defense of Poesy*," by Irene Samuel. *Modern Language Quarterly*, I, 3 (1940), 383–391.

"Hume and the Scottish Shakespeare," by Ernest C. Mossner. *The Huntington Library Quarterly*, III, 4 (1940), 419–441.

"Shelley, Godwin, Hume, and the Doctrine of Necessity." Frank B. Evans, III. *Studies in Philology*. XXXVII, 4 (Oct. 1940), 632–640.—Godwin borrowed his account of the doctrine of necessity from Hume, and Shelley in turn borrowed most of his note (to Queen Mab) from both. There is none of Hume's scepticism, however, in Godwin or Shelley.

"Truth in Biography: Leonardo and Freud." by Jacques Barzun. 253–258; "Roots of American Realism," by Walter Blair. 275–281. *The University Review*, VI, 4 (1940).

"Symposium on Characteristics of American Culture and its Place in General Culture," held at Philadelphia, April 19, 1940. *Proceedings of the American Philosophical Society*, 83: 4 (Sept. 20, 1940) 515–588. $.50.—Frederick P. Keppel, Frederick L. Allen, Alfred V. Kidder, Lewis Mumford, Van Wyck Brooks, Francis H. Taylor, Otto Luening, Arthur H. Compton, and Gilbert Chinard discuss the present condition of American arts and sciences in the midst of the world upheaval.

"The Background for Hitler in German Thought," by Julius Seelye Bixler. *The American Scholar*, IX, 9 (1940), 437–448.

"Racial Theories in Germany from Herder to Hitler," by Charles Tansill. *Thought*, XV, 58 (1940), 453–468.

"The State of Nature and the Decline of Lockian Political Theory in England, 1760–1800," by H. V. S. Ogden. *The American Historical Review*, XLVI, 1 (1940), 21–44.

"Marranos and Racial Antisemitism. A Study in Parallels," by Cecil Roth. *Jewish Social Studies*, II, 3 (1940), 239–248.

"Jewish Social Studies, 1938–39. A Selected Bibliography," by Salo W. Baron. *Jewish Social Studies*, II, 3 (1940), 305–388.

"Corporative Organization of the Third Reich," by Taylor Cole. *The Review of Politics*, II, 4 (1940), 438–462.

"The Evolution of Soviet Constitutional Law," by N. N. Alexeiev. *The Review of Politics*, II, 4 (1940), 463–476.

"Kierkegaard and Classical Philosophy," by John Wild; "Lévy-Bruhl's Contribution to the Study of Primitive Mentality," by Frederica de Laguna; "Plato and the Unity of Science," by Friedrich Solmsen. *The Philosophical Review*, XLIX, 5 (1940).

"Elementary and Secondary Education in the Middle Ages," by Lynn Thorndike. *Speculum*, XV, 4 (1940), 400–408.

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